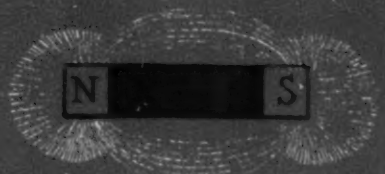
DECEMBER 2, 1957 PRICE 50 CENTS

R and D RESEARCH and DEVELOPMENT edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT



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Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D Research and Development Edition

December 2, 1957 Vol. 28, No. 22

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Product Engineering ..... SIDELIGHTS

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N S

●**Researchers** at General Electric described Alnico V crystals (see p. 34) as "lima-bean-shaped or, perhaps, a bit like a close-packed structure of peanuts." Scientists at Philips Research Labs, Netherlands, heard of the GE description and sent in several "highly resolved electron micrographs of Alnico V" which bore a remarkable resemblance to the GE description. On closer inspection, in fact, the peanut-shaped particles in one photo revealed themselves as—you guessed it—peanuts!

●**Digital computers** are proving to be management's best friend in operations research (p. 37). They have also been invaluable in the solution of many complex engineering problems. For example, engineers at one Midwestern plant have their computer select a random number every morning. Each staff member then punches a number in turn. The computer in each case indicates the direction of variance from the original random number, and each man must reduce his variance. Eventually somebody selects the right number—and buys coffee for the crowd.

●**In Schenectady,** on vacation with his wife our Design Digest editor was prevailed upon to get the value-analysis article in this issue (p. 30). Mrs. A sat comfortably in the lobby knitting away at a sweater while her spouse visited various company officials. She was soon joined by a tall, thin, vendor's representative who proved very knowledgeable about sweater seams and turning the heels of socks. Seems he had been knitting his own for years—no store-boughten sweater ever fit him.

●**In Washington** to cover a conference last week one of our editors found himself with a free afternoon and, screwing up his courage, resolved to visit the Soviet Embassy. Red carpeting covers the floors (wall-to-wall), red upholstery covers the formal settees, and the foyer walls are all mirrored (one way?) The receptionist was gracious but uninformative. The Third Secretary would return either in a half hour or an hour and a half (translation problems) and would be delighted to talk at length about Sputnik. The FBI can stop shadowing our editor (please!)—he learned nothing new, and had no secrets to sell.

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READER TO EDITOR

Radar Controls Traffic

To the Editor:

In your Nov. 4 issue, you expressed the wish for a traffic-light control operated by radar. ("Why don't they research and develop," p. 62) This wish has already been fulfilled. Automatic Signal Div. of Eastern Industries in Norwalk, Conn. has been making such a device for at least a year. It works, too!

—LEONARD GREER
Senior Engineer
Penn-Union Electric Corp.
Erie, Penna.

• *Reader Greer is correct. We have found that the system has been in use for several years in Philadelphia and Baltimore.—Ed.*

PE Should Act, Not Talk

To the Editor:

It seems to me that Mr. Damelio's query, "What is an Engineer?" (Oct. 21, p. 54), is significant. If we agreed upon what an engineer is, it might clear some of the fog. A physicist is one who discovers the laws of nature (or used to be so considered, at any rate). I suggest that we define an engineer as: one who applies these laws to particular purposes, being assisted by others of lesser status called "designers" and "draftsmen."

Your sharp disagreement with Mr. Gariss' remarks "Are We Short of Engineers?" (Oct. 21, p. 53), is not very convincing. I haven't read your citations. I have heard the complaints of hundreds of drawing-board engineers. Mr. Gariss' report is highly representative. Have you thought of conducting an objective survey free of arm-wavings, semantic gymnastics and other propagandistic devices? Would it be considered amiss to carry this search to the grass roots, rather than past sources?

Now that Muttnik is up there, would it be thought subversive to acknowledge that it's time to make less noise and show more results in our engineering output? We have a huge pool of men who would like to produce results. Strange as it may seem, there are men who enjoy producing objective results. How many such men have left defense work altogether? How many more will, the first chance they get? There is much data in the situation. A scientific approach to it might yield astonishing results.

—NATHANIEL ARCHER
Los Angeles, Calif.

Surplus, NOT Shortage

To the Editor:

It is satisfying to know that other engineers are recognizing the SURPLUS of experienced engineers—yes, SURPLUS; not SHORTAGE.

Your article on the increases that engineers received during the 1953 to 1956 period implied that engineers are now enjoying a restoration of their economic position, since they received 25% increase compared to a 12% general increase. This is rather insulting to anyone acquainted with the facts.

For example, the experienced engineers with 30 and 40 years' experience had increases of only 21% and 12% respectively during the period 1939 to 1946, while manufacturing wages rose 80%.

This sad condition became worse between 1946 and 1952 because, in lieu of percentage raises, engineers continued to receive "cost of living" increases which were "across the board."

As to your editorial comment in answer to Mr. Gariss' inference regarding your knowledge of engineering conditions, it is easy to pat yourself on the back. It is simple to interview editors and management personnel who pay for advertisements and conclude there is a shortage of engineers. They want lots of cheap engineering help.

If you are not afraid of offending your advertisers, why not go back to the Engineers Joint Council engineering surveys of 1939 and 1946 and bring them up to date with general labor increases in other professions?

Don't use misleading surveys such as the 1949-1950 US Dept. of Labor survey of engineers, which was based on senior engineers only. Also, try to compare technical and design engineers, not administrators and management.

Such a survey, well advertised through all McGraw-Hill publications, would be a patriotic service. It would effectively help adjust experienced engineers' salaries up to where bright young men could once again see a favorable economic future in the engineering profession.

We need quality engineers, not a lot of low-priced engineering flunkeys.

—H. W. CORDES, P. E.
Palo Alto, Calif.

Who Says There's a Shortage?

To the Editor:

It is interesting to note the response from various readers engaged in engineering practice to your editorial entitled "Are We Short of Engineers?" (Sept. 23, p. 23). From the long-term point of view, which you have quoted a number of times, the real problem appears to lie in an expanding technological society creating more and more adequate definition of an engineer and his status, coupled with a more professional approach to his livelihood. There will be a continuing shortage of "engineers" working at the draftsman and technician level. Unfortunately, the only means for evaluating the status of the professional engineer in our economy is by remuneration. This remuneration has been obtained not by the engineer per se, but rather by specialists working in narrowly defined scientific fields having extensive shortages. Can we truly state today that there is an extensive shortage of engineers specializing in stationary power-plant design and development, or rather is there a shortage of electronic engineers needed to develop control systems? It is my own contention that these shortages are quite stratified and selective in need.

The Editor's rebuttal to Mr. Gariss, in which he quotes 27 editors available to PRODUCT ENGINEERING and their freedom of access to an unlimited number of opinions and studies available to provide adequate data, does not necessarily make an article factual or correct. There has been a popular trend to shout that we are short of engineers and this has been the hue and cry of many com-

(*Continued on page 6*)

MINIATURIZATION AWARD

MPB

THE AWARD

Miniature Precision Bearings, Inc. cordially invites you to participate in the Annual Miniaturization Award Competition. The Miniaturization Award for 1957 will be presented on March 23, 1958 at the 1st Annual Awards Dinner in New York. The Award will consist of a piece of original sculpture, symbolizing miniaturization, by a leading American artist, which is cast in bronze and inscribed. There will also be Honorable Mentions for additional outstanding contributions.

PURPOSE OF THE AWARD

To increase public knowledge of the importance of miniaturization and to stimulate further activity within industry toward the advancement of the concept of miniaturization.

CRITERIA FOR AWARD

Contributions considered for the Award should have been made in the recent past to be eligible for consideration by the Miniaturization Awards Committee. Details of criteria on which awards will be based can be obtained by writing: Awards Committee, Miniature Precision Bearings, Inc., Precision Park, Keene, N. H.

JUDGING OF ENTRIES

The awards will be judged by an eight-man independent committee comprised of the following individuals: R. L. Goetzenberger, *Educational Consultant, Minneapolis-Honeywell Regulator Co.* / Dr. George H. Lee, *Director of Research, Rensselaer Polytechnic Institute* / Morton Pavane, *Electronics Engineer, Air Research and Development Command* / Gerard Piel, *Publisher,* SCIENTIFIC AMERICAN / Gustave Shapiro, *Chief, Engineering Electronics Section, Electricity and Electronics Division, National Bureau of Standards* / George F. Sullivan, *Editor,* THE IRON AGE / Elmer Tangerman, *Editor,* PRODUCT ENGINEERING / Arthur W. Weber, *Vice President, Engineering & Manufacturing, Corning Glass Works* / Horace D. Gilbert, *President, Miniature Precision Bearings, Inc.*

ENTRIES

Description of a specific contribution should be made in as complete a form as possible and mailed to the Awards Committee, Miniature Precision Bearings, Inc., Precision Park, Keene, New Hampshire. Samples of the product itself, blueprints or photographs will be helpful. Descriptive information should include some of the design characteristics of the product and the specific problem solved by the miniaturization effort.

DEADLINE

In order to be considered for the 1957 Miniaturization Award, entries must be received by the Awards Committee by January 31, 1958.

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panies just desiring to fill their manpower needs rather than analyze their utilization of personnel. It is this hue and cry which makes up the great part of the "demand" for engineers.

The excellent book on future resources, entitled, "The Next One Hundred Years," (Ed: Reviewed Sept 9, p. 67) has been in print approximately six months. Already it appears to be out of date with respect to its analysis of the "engineering shortage."

—Samuel L. Sola
Santa Monica, Calif.

Mr. Gariss Speaks Again

To the Editor:

May I first clarify one point in my letter (Oct. 21, p. 54). I did not "miss the point of the editorial." I realized that Product Engineering was talking about the long-term situation—and that is exactly my concern. I would like to see a balance between the engineering and scientific positions and the number of professional personnel available. In addition, I would like to see the capabilities and potentials of each scientist or engineer raised, as well as the public recognition he receives.

This goal cannot be attained by proclaiming shortages of personnel and encouraging mass education of would-be engineers. It can be done by raising the standards required of the engineer (for convenience and not by intent I will delete scientist) and temporarily decreasing the supply. Thus those available will be forced to produce more and their capabilities will not be exhausted tending to administrative and routine details. Employers simply will not be able to afford it. As advocated in my previous letter, I heartily recommend that encouragement be given to young men and women to become draftsmen and technicians. By having these trained personnel available, the engineer can become more proficient. I will admit that I cannot place my finger on a recommended extent of education for them. Perhaps, the engineer of the future should be required to get a Master's or Doctor's degree and the technician should graduate from at least a junior college or even perhaps college.

The standards set and the methods used by the American Medical Association should not be overlooked. Even though there is a shortage of medical men in our country, the AMA does not recommend wholesale education as a solution. The standards are not lowered and all applicants are carefully screened before they enter medical schools. This is the type of approach the engineering profession should adopt today.

I will admit that I became somewhat incensed at your editorial—it wouldn't be a good editorial if it did not arouse the reader. I intentionally overstated my case to attract your attention—rational letters are conveniently filed. I am reminded at this point of a line in the Northwest Professional Engineer (published by Seattle Professional Engineering Employee Association) by Daniel Shafer, "Isn't it wonderful how the current engineering shortage was solved by releasing a thousand engineers from North American?" As to the future we all can merely gaze into crystal balls. Are you really certain that there will be a shortage?

I am quite certain that our previous "shortage" was created by management in the management-employee war. By convincing young people entering college or thinking of entering that there is a shortage, management assure themselves of an adequate supply and selection. I cannot verify this but I have heard people representing the management of a large airplane company state (this was in 1956) that this large company hired seven engineers to obtain one good one. The other six eventually terminated or were working in administrative positions. Of course, this statement was made during a discussion on how the training received in colleges had deteriorated. What can one believe?

—W. J. Gariss
Bellevue, Wash.

• *It is significant that the preceding letters come from the West Coast, where engineers have been enticed by all sorts of offers, stockpiled on low-level jobs, most affected by past discriminatory labor practices and by recent cutbacks. They reflect an attitude that is characteristic of "worker-management" contention at any level anywhere.*

Obviously, the key question is what "engineer" means. Mr. Archer and Mr. Cordes both raise it. Is there an education requirement, an experience requirement, a license requirement? Obviously, there hasn't been. Is a "designer" of lesser status than an "engineer", as Mr. Archer suggests? Does an engineer who becomes a part of management cease to be an engineer, as Mr. Cordes suggests? Should engineers be paid so well they won't want management jobs, as Mr. Gariss seems to think?

Mr. Gariss makes good points about raising the standards for engineers—then leaves us gasping by objecting to the obviously practical application of such standards by one airplane company. The company in question rids itself of unsuitable engineers, apparently, either by termination or by "kicking them upstairs" into management. Here is the indication that management is a wrong step for the engineer—a direct reversal of what's been preached at us ever since Horatio Alger was required reading.

There is, of course, always the possibility that an excellent engineer may neither be interested in, nor suited to, management. Several companies now recognize this possibility and give prestige and emoluments to the engineer and the manager in equal degree—a key engineer, with no management responsibilities, in a given department may be higher paid than the manager!

"Figures don't lie, but liars figure" is a cliche, but still appropriate on surveys. Two surveys of the same subject give differing results; two interpretations of the same survey differ. Thus we might argue endlessly about whose surveys to believe. And any survey undertaken in this area would be challenged by outsiders who disagreed with the findings or who had an axe to grind. It is difficult to make an "objective" survey; Mr. Cordes, for example, won't accept even Dept. of Labor figures. The EJC proposes to make a study of the profession, has $50,000 from the founder societies to survey the problem. Best estimates of cost, $1 million; of time, "several years." But unless engineers can agree at the outset on a definition for "engineer", we'd better save the million. Also, we reported the EJC surveys mentioned by Mr. Cordes back in March ("Are You Paid What You're Worth"—p. 140). Then we had several critical letters from management in substandard salary areas.

Perhaps the question isn't whether or not a shortage exists but whether the engineers we have are being encouraged to think—to progress as individuals, as representatives of science, and as members of a society, perforce now science-oriented. To this question I think we all agree—the answer is too often no, and if it continues to be no the world (and US especially) will be in serious trouble soon.

—EJT

American ... DEVELOPMENTS TO WATCH...

Tolerances never before possible . . .

. . . in sheet-metal parts can be met by a new metal-working process called "compression forming," Lockheed Aircraft Corp. claims. The metal is first formed to broad tolerances in a Hydropress, heat-treated, then subjected to high pressure in a specially designed compression die where, Lockheed says, "both the surface and the edges of the part are compressed, forcing the metal to flow and set precisely against the face of the die." Sheet-metal parts finished this way "are three times more precise than those made by standard forming methods, and "much sharper flange radii," permit location of rivets closer to the web. Lockheed says it also permits a reduction in web size.

Reproducible thermal shock test . . .

. . . for porcelain enamels is reported by Porcelain Enamel Institute members J. H. Giles, Jr. and J. C. Richmond, O. Hommel Co. They heat a metal specimen to test temperature, then drop a small quantity of water onto its surface through an opening in the furnace. The initial test temperature is 250 F, and this is increased in 25° steps until failure occurs. (Failure is measured by the craze pattern which appears when the surface is stained with an organic dye.) Their furnace was made by winding Nichrome wire on a ceramic-coated Inconel core (an ordinary hot plate did not prove satisfactory).

For best reproducibility of the tests, enamel thickness, base metal thickness and amount of quenching water should be controlled rather carefully. A change of about 2 mils enamel thickness, for instance, can increase the tendency to failure.

Disappearing films may hold the key . . .

. . . to design of temporary or safety diaphragms, production of special types of electrical mesh, and other unusual product problems. In electrical mesh, for instance, when a special type of spacing is needed, thin tapes of water-soluble film can be woven into the grid, then dissolved out to leave the desired gaps.

At least three types of water-soluble films, engineered to meet just such needs, have been developed. Newest is a group of high-molecular-weight polymers of ethylene oxide, scheduled for commercial production by Union Carbide Chemicals Co. early next year. Already on the market are alginate films (from seaweed derivatives) and several polyvinyl alcohol water-soluble films. The former have, thus far, been used only for food products; but the latter are already moving into a wide variety of packaging applications—inks, detergents, bleaches, and other powdered materials ("just drop the whole package in the water").

Feature of such films is strength and durability under normal handling conditions, and resistance to many oils and greases that attack other plastic-type materials. This might make them useful, for example, as safety diaphragms in systems where oil normally circulates, to indicate when a water leak occurs.

Water-soluble films can be made tough, flexible, and elastic, are surprisingly durable until actually immersed in water. Union Carbide says they can be stretched, as here, to almost 10 times original length, will return to shape when heated. Tensile strength is about 2000 psi.

American...

(continued)

DEVELOPMENTS TO WATCH...

Magnets fine as a human hair . . .

. . . are being drawn of Cunife (copper-nickel-iron alloy) at National Bureau of Standards. Cunife is one of the few magnetic materials that can be so worked, but cold-drawing caused a big drop in coercive force. Now, NBS finds a post-drawing heat treatment at about 1120 F can fully restore the magnetic strength of the material, as long as the reduction does not exceed 85%. Says NBS: "Magnets of Cunife as small as 0.005 in., satisfactory for use in magnetometers and galvanometers, can now be produced." (For other developments in magnetic technology see page 34.)

Higher-quality carbon . . .

. . . on an almost made-to-order basis is promised by an electrical baking process national carbon developed it and says it will cut manufacturing time "from 8 weeks to 8 min," permit processing far smaller-batches, turn out a product "unique in its low permeability properties." NCC doesn't promise price reductions as a result of the new technique, but hopes it will hold the line against rise.

Cellular plastic insulation . . .

. . . is ready for large-scale use in home appliances, F. R. Marshall, Westinghouse project engineer, told the SPI at a recent meeting. Westinghouse finds polystyrene foam resists moisture pickup, provides structural strength as well as thermal protection, and can be produced for approximately 1/6 the cost of tooling a conventional cabinet.

But two other popular and highly touted materials (one a mineral fiber and the other a new plastic foam) are not proving out. Both tend to pick up moisture, and are too expensive. Marshall thinks, though, that both limitations can be overcome—perhaps very soon.

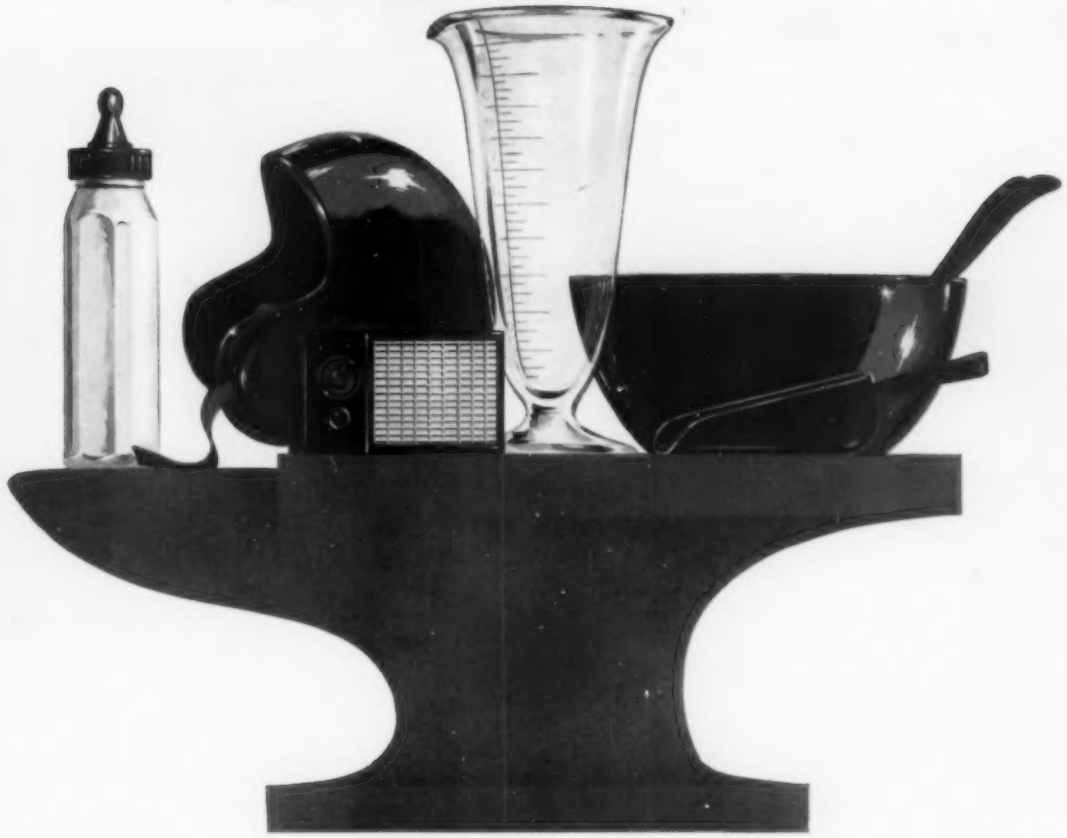
Marshall also outlined the major design criteria for selecting refrigerator thermal insulation: thermal conductivity of 0.24 to 0.27 Btu./hr./sq ft/°F/in.; low water vapor transmission rate; low water absorption; long-term (at least 10 years) retention of insulating ability; structural strength and rigidity; flatness and warp-resistance; ease of fabrication; freedom from odor; low cost; light weight. (For more data on insulating materials, see Nov. 11, p. 97.)

New family of batteries . . .

. . . under test at National Bureau of Standards, uses solid wax electrolytes in place of conventional materials. One battery for instance, is a low-current, punched-cell unit using solid polyethylene glycol in a three-layer sandwich: a zinc sheet, etched to increase its adherence to the wax; a paper or nonwoven fabric separator, coated on one side with a zinc-chloride, polythylene-glycol mixture, and on the other with the same combination plus manganese dioxide; and a conductive vinyl-plastic sheet. Disks stamped from this composite material are stacked, 25 or more in a pile, and lacquered together. Says the Bureau: A cell of this type weighs 0.05 oz, is ¼ in. dia and 0.3 in. long, has an EMF of 37.5 v and a short-circuit current of 3×10^{-6} amp. Temperature range is about 32F to 110F. Another type, using a gel electrolyte, has a wider range, but its shelf life is not as good.

Dime-size high-voltage batteries are made by stacking zinc-wax sandwiches, then coating them with lacquer. These have 25 cells. The big one at the left is ½ in. in dia.

For sturdy plastics . . .



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DEVELOPMENTS TO WATCH...

Radiation vulcanization of rubber . . .

. . . is still a long way off, as far as practical application goes. There's no doubt electron beams and radioisotopes can do the job. But, says C. H. Stockman, Goodrich research scientist, the radiation dosage required is very large (10 to 50 megareps, compared to 1 or 2 for many chemical and food-processing operations). "Currently," he says, "it costs less than a dollar to vulcanize a standard passenger tire by the conventional sulfur-and-heat method. To perform this vulcanization with a 10-kw, 2-million-electron-volt high-energy machine would cost about $8.15," provided radiation losses were minimized, with special precautions taken to prevent absorption by the mold.

It may be that when spent nuclear-reactor fuel elements become available from central processing plants the costs could be brought down a good deal. But several speakers at recent Atomic Industrial Forum meetings indicated this is a far-off solution. Another approach may pay off sooner: developing radiation-sensitive elastomers that can be vulcanized much more easily. Some progress has already been made in this direction, and several rubber companies are working on it.

A mechanical-optical system that replaces . . .

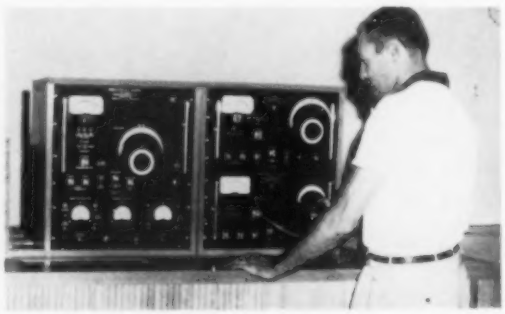
. . . tedious hand-drawing methods long used for making animated movies could be important for two reasons: It represents the first break towards mechanization in this manual field; it promises to cut the cost of animation "as much as 75%," bringing demonstration films of mechanical devices down to a price that should permit far wider use. Anime, Inc., 45 W. 45th St., New York 36, which developed the system, has so far applied it only to producing TV movies. But company executives say there is no reason why industrial films could not be made—and are ready and willing to try.

Information center on radiation effects . . .

. . . is being set up by the Air Force at Battelle Memorial Institute to "gather and disseminate data concerning the effects of nuclear radiation on materials and systems which may be required in aircraft of the future." The center's services will be extended to other government agencies, as directed by the Air Force, and should, simply by coordinating the mass of facts and figures now becoming available on this subject, eventually prove useful to any engineer concerned with design of equipment for nuclear reactors (including auxiliary valves, pumps, heat exchangers, and the like), and with use of nuclear materials (radioisotopes, for instance) in product design and development. —A. R. G.

Tester for electronic testers . . .

. . . a new calibration standard built by Weinschel Engineering for the Air Research & Development Command, should make it possible to meet higher standards of accuracy, may result in tighter specifications for civilian as well as military equipment. (No commercial units have been built thus far, though.) With the tester, power from 100 to 4000 megacycles, ranging from 25 microwatts to 2 watts, can be measured with an accuracy of plus or minus 2% of the actual reading; voltages can be held to the same accuracy; and attenuation held to an accuracy of plus or minus 0.02 db per 10 db over the full range of 0 to 120 db.



Super tester for electronic equipment consists of direct read-out precision power meter and voltage ratio calibrator. Air Force plans to install units of this type at several of its equipment-certifying and acceptance depots.

NEW LOW-COST COMPUTER WITH ADVANCED COMPUTING TECHNIQUES

The only desk-side electronic computer with direct programming and automatic positioning of decimal point

A few applications of the 610 Auto-Point Computer

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Mass Spectrometric Data

•

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Calculation
of Aeroelasticity

•

Data Reduction

Two *exclusive* features of the new IBM 610 Auto-Point Computer help make your engineering time more completely creative. First, direct programming: computation takes place as the program *is being written*, eliminating the need for separate program test runs. Second, automatic positioning of decimal point: the engineer is relieved of the burden of planning movement of the decimal point, greatly reducing problem-solution time.

The new Auto-Point Computer also gives you, among other valuable features, single-instruction square root, simultaneous division and multiplication, and highly flexible tape units. The IBM 610 was designed with reliability as a prime consideration; built-in self-checking provides assurance of accuracy. In addition, this low-cost electronic desk-side computer does not require air conditioning.

Discover today how the mobile IBM 610 can solve a wide range of scientific and engineering problems for *your* business. For details, simply call the local IBM representative.

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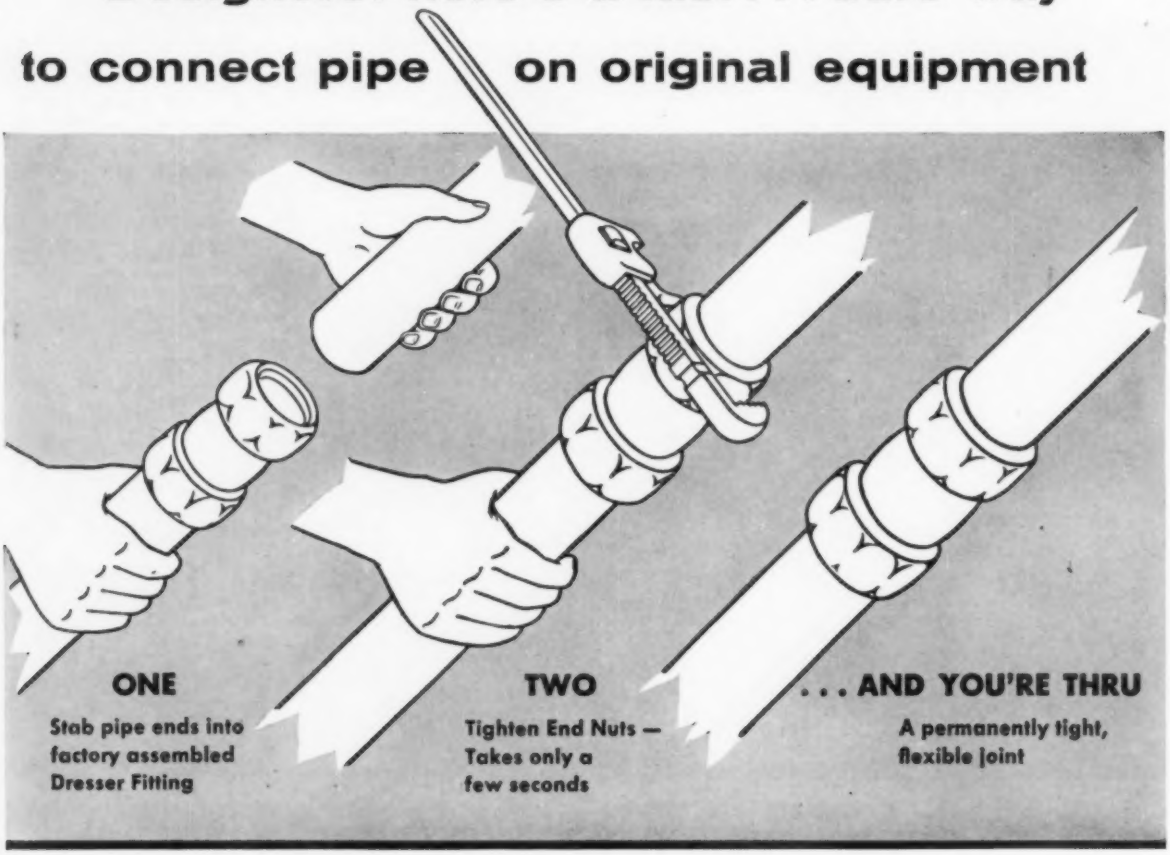
Designers: here's a fast . . . sure way to connect pipe on original equipment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Stab pipe ends into factory assembled Dresser Fitting
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Tighten End Nuts — Takes only a few seconds
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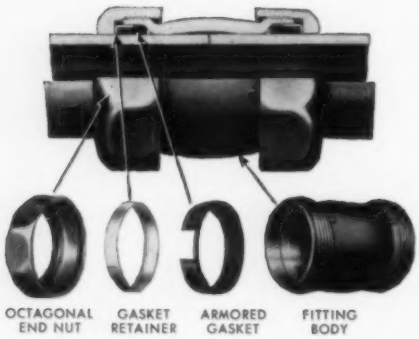

Every connection is permanently tight, leakproof, yet can be disassembled in seconds when equipment needs servicing. Only a wrench is needed.

Even if pipe ends are not in alignment, a tight joint is assured because of the resilience of the Dresser gasket. Dresser Fittings absorb vibration without leakage.

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DEVELOPMENTS TO WATCH...

At least one more generation of missiles . . .

. . . will be using aluminum and magnesium, still considered the best metals for missile airframes. So says a first-draft report to the Pentagon titled "An Evaluation of Structural Sheet Materials in Missile Application."

The finished report, a year in preparation, will be available within the next couple of months. It was ordered by the Department of Defense to determine if more titanium could be pumped into the missile program.

The report goes into the relative merits of selecting materials by the conventional minimum-weight criteria associated with transient heating conditions and some other factors, such as: fabrication, corrosion, cost, etc.

It concludes that, "because of the low structural indices under which missile airframes are designed, such materials as magnesium and aluminum show superior weight advantages in the airframe over titanium and stainless steel."

Increases in the strength of steels and titanium alloys are not likely to change the situation, says the report.

A high-strength, weldable titanium alloy sheet coupled with a "marked" reduction in cost could cause a shift in metal use, though.

Scrap metal prices may be dropping . . .

. . . because of the government's recently announced program to scrap obsolete merchant ships now mothballed around the country. One hundred already slated for the scrap yard are just the first of the deadwood to be weeded from some 1800 merchant ships now in mothballs. Estimates are that as much as ⅓ of the reserve fleet may be scrapped.

This action is tied to the mammoth shipbuilding program now getting underway. Up to 500 new ships will be built over the next 10 to 15 years. Plans are to scrap older ships, as later versions are turned in to the government, as part payment for new ships.

Look for a sharp upturn . . .

. . . in military research and development programs. President Eisenhower threw full White House backing behind the issue in his second "chins-up" talk. This time, he made it clear that more money was to be pumped into the program.

A scant five hours before the President's Oklahoma speech, the Department of Defense Director of Science, Dr. Orr E. Reynolds, said military research spending may be doubled next year. Right now it is running around $90 million a year.

While the Pentagon indicated higher spending for research, it also made public a new defense-policy directive reaffirming Pentagon support of basic-research programs.

Defense spending up $1 to 2 billion next year . . .

. . . now that the President has punctured the spending ceiling to bolster defense efforts. Defense contractors working on non-missile items are in line for more cuts, according to Defense Sec. McElroy. A substantial part of the defense increase will come from cuts within present military spending program. The paring will be felt in the next few months.

Cuts, when they come, are expected to be in all fields of conventional warfare items. Aircraft production seems sure to be hit hard. Top priority now goes to missile and research programs. The big emphasis now is to negotiate for overseas bases for the 1500-mile IRBM's. It would be a stopgap measure until the larger ICBM's can be perfected. Two IRBMs—the Army's *Jupiter* and the Air Force's *Thor*—are in the test stage, and one should be chosen for production within the next few months.

New offices are being created to keep closer tab on the missiles. William Holaday was named as Director of Guided Missiles for the Dept. of Defense. In addition to Holaday, the Pentagon will soon set up managers for individual programs—the anti-missile missile, for example. These programs will be developed under this system until operational. It is a move to cut interservice rivalry in new weapon development.

CRYOGENIC PUMP IS NOTEWORTHY NEW INDUSTRY DEVELOPMENT

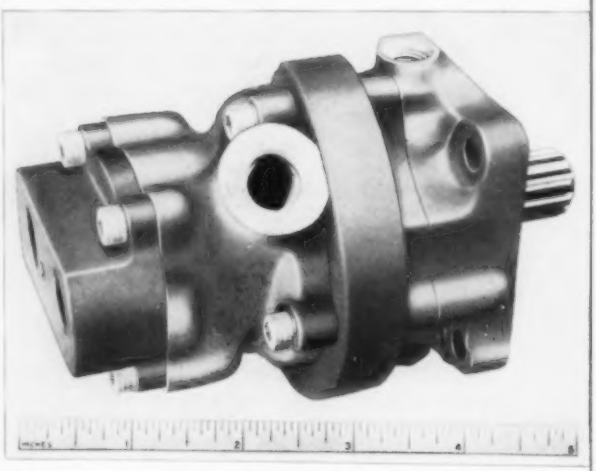
A product of Sundstrand-Denver, it has a demonstrated capability of pumping liquid nitrogen at pressures over 3000 psi at speeds of over 3500 RPM.

Piston type, extremely compact and lightweight, it has been under experimental development for a year and is suitable for pumping liquid gases such as nitrogen and oxygen. Sustained operating periods have been obtained repeatedly without any form of lubrication.

The pump is a design modification of a Sundstrand hydraulic motor which is made in many sizes and thus other larger capacity pumps can be provided with relatively little development.

The pump shown here has nine axial pistons and is of fixed displacement type. Metal parts have been selected to be compatible with liquid nitrogen. Minor material changes can be incorporated for satisfactory operation with the use of liquid oxygen.

The result of precision engineering and careful testing, these pumps appear to be the solution to many of the high power-to-weight problems encountered with missiles, rockets and high performance fighter planes; and, will prove highly useful for aircraft cooling systems and ground support equipment. Variation in orientation, size, mounting and assembly of these self-contained units can be supplied to suit your individual needs. For further information on using these pumps to solve your cryogenic pumping problems contact:



PERFORMANCE DATA
SUNDSTRAND-DENVER CRYOGENIC PUMP

Displacement	0.130 cu. in./rev.
Capacity @ 3500 RPM	1.75 gpm
Horsepower @ 3500 RPM	3.8 HP
Volumetric Efficiency @ 3000 PSI	90%
Weight	2.5 lbs.
AND Mounting Flange	10260 Type X
Dwg. No.	ED699

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DEVELOPMENTS TO WATCH...

Paul Bunyan had better look to his laurels . . .

. . . The Austrians now have a wood crasher that "makes an axe for chopping wood into small pieces entirely obsolete." The unique device is a steel cone with wood-screw threads on top, a smooth center section, and a ring at the base. It will work directly off almost any rotary power source. The threaded tip drills itself into the wood, the rest of the cone literally squeezes the wood apart, and chips are broken away by the ring. Distributor of the device, H. P. Paul Co., Vienna IV, says it is entirely safe, and permits one man to chop up more than 70 ft of wood an hour.

Electronic megaphone . . .

. . . designed in Norway by Den Norske Hoyttalerfabrikk A/S, Kragero, is completely self-contained, weighs only 4½ lb (with batteries), yet amplifies 30 times and has a calling range of 1,100 yards. The secret: transistors and other miniaturized components. Batteries are standard type and are located in the gun-type handle. The megaphone is 12 in. long, and has an 8-in. speaker.

Rumanians claim nickel-free alloy steel . . .

. . . that can "meet the needs of the machine-building and oil industries for a high-grade, low-sulfur material." No specific information on composition is available, but the Rumanian Metallurgical Research Institute says such elements as titanium, chromium and manganese replace the usual nickel content, and that processing methods play an important role in developing needed properties.

Biggest truck ever built, anywhere . . .

. . . is claimed by the Berliet Company of France. Designed for use in the Sahara Desert, it is 44.3 ft long, 15 ft wide, is powered by a 600-hp diesel, has a max speed of 29 mph. Price: a mere $119,000. (The tires themselves are over 6 ft dia, are steel-reinforced, and cost $1400 each.) A prototype unit now under test is said to operate well, even in 143-F heat and Berliet is preparing for quantity production.

Going in the opposite direction, the Vespa auto company is proudly displaying a car weighing only 770 lb, measuring 9 by 4 ft, and priced at under $850. *France Actuelle* reports the car has an air-cooled, 1.4-cu ft, 2-cycle, 2-cyl rear- mounted motor, has top speed of 62 mph:, and gets 50 miles to a gallon.

The French seem to be out to break records in a lot of fields these days. Another recent announcement tells of an electronic computer called the Gamma 60, made by the Bull Co. of Paris, that "can perform 100,000 operations in a second," has a built-in verifier, and "makes full use of the latest electronics devices, including transistors."

Mammoth truck can carry a payload of 50 to 70 tons over sand. Its French manufacturer is also designing flat-bed and dump-truck models of 48-ton and 68-ton capacity.

What's happening in SCIENCE

Cryogenics: a hot trail to cold facts

At least one laboratory science is finding practical application even before its name is widely known. It's cryogenics, the science of cold, and deals with the properties of materials at temperatures close to absolute zero. They're turning out to be exciting properties:

At ultralow temperatures, free radicals can be captured—and perhaps used to propel rockets (see Oct. 7, p. 15). Many metals become amazingly strong—particularly those with a face-centured cubic structure; and others become superconducting. Their resistance drops almost to zero, and they can be made to perform strange and useful electrical tricks.

Taking advantage of this fact, several laboratories are designing computer elements whose operation is based on the creation of superconductivity and its destruction by a magnetic field (see Sept. 9, p. 16 and diagram below).

Superconducting memories, IBM reports, have many advantages; among them: extremely fast action (about 100 times faster than the ferrite-core memories now in use), compact design, absence of delta-noise, ability to hold a trapped flux for long periods—two years or more.

Both computer elements operate in and at the temperature of liquid helium minus 453 F (4.2 K). This originally was about the limit of the cryogenic field. Now, though the Bureau of Standards says the term is applied to temperatures up to −280 F (100 K). On this basis, liquid hydrogen (−423 F), liquid nitrogen (−320 F), and liquid oxygen (−297 F) all fall within the cryogenic range; and such components as Keystone Carbon Co.'s new thermistors, designed for use in the range between liquid oxygen and liquid hydrogen, are considered commercial cryogenic devices. Likewise, the De Carbon shock absorber, now in use on several makes of French cars, is an application of cryogenics. It uses liquid nitrogen in one chamber of the pressure unit.

Among the laboratories now actively researching the cryogenic field, in addition to those mentioned above, are Arthur D. Little, Inc. (designer of the Cryostat for liquefying helium), Bell Telephone Laboratories, Ford Motor Company's Scientific Laboratory, and the University of Chicago's Institute of Metals.

How many atomic particles?

Remember when an atom was just a neat assembly of orbiting electrons and a nucleus of neutrons and protons? That wasn't very long ago. Now, there are arephotons and positrons, neutrinos, anti-protons, and anti-neutrons. Furthermore, the latest University of California list identifies 14 kinds of mesons, some "light" and some heavy, and five types of hyperons —with more to come.

Dr. Edward Teller, atomic energy pioneer and professor of physics at U. C., says still-unexplained nuclear phenomena call for the existence of at least two more nuclear particles, intermediate in size between mesons and hyperons. Both would be difficult to detect by present methods because they are short-lived and neutral in charge. But, he says, their existence would help many observations in high-energy physics.

What do all these particles do? Some, like the proton, are basic building blocks of matter. Others—like anti-neutron and anti-proton—seem to be produced by high-energy nucleon collisions, and annihilated in the same way. And still others—some of the mesons, for example—seem simply to be decay products, formed when primary particles disintegrate.

Quiet! noise researchers at work

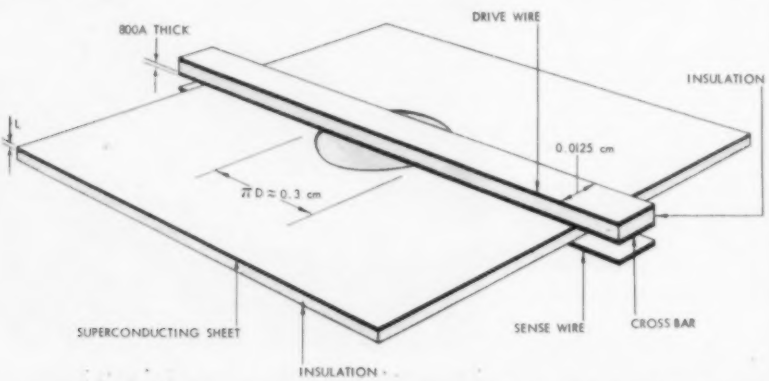
From the National Inventors' Council comes a plea for turbojet engine noise-suppressors and for silent engines to power electric generators and propel boats. From manufacturers, worried over the relationship between noise and hearing loss, come demands for quieter production machines.

Much has been done in the design area to cut the decibel level of products: noise-absorbers, quieter-operating materials, fewer moving parts. (See Nov. 25 issue for article "Less Noise from Small Engines.")

Still, much remains to be learned about sound and how to stop it. One fruitful line of research, perhaps, is creation of quiet areas by sound-interference, though this might be difficult to apply to individual products. Materials research might be even more fruitful, as witness the recent development of microwave absorbers that now hold promise as radar screens.

It's a wide-open field, and one where basic research could become applied research in a very short time.

—A. R. G.



Memory cell model shows construction of IBM cryogenic unit. Superconducting sheet is vacuum-deposited lead film; center hole represents built-in flux-trapping imperfection.

What's happening in MATERIALS

USSR outspeeds US in metals

Production of aluminum, copper and steel in the US is rising, but its share of the world total is not. The reason: USSR production is increasing even faster. That's what recent National Industrial Conference Board figures show.

In the past 10 years, our aluminum production has more than doubled, but the USSR's has increased more than four-fold. Our production of copper and steel has gone up about 30%, while in the USSR it has jumped more than 200%.

Latest NICB figures (1956) for the USSR: steel, 53 million net tons; aluminum, 485,000 net tons; copper, 417,000 net tons; for the U.S.: 115 million, 1.7 million, 1.1 million.

Columbium: moving fast

Now that columbium's no longer a scarce metal (see Nov. 4, p. 14), things are really beginning to happen. Major research efforts are being aimed at overcoming problems with this metal, price schedules are being revised; and new suppliers are entering the field. Newest of these is Electro Metallurgical Company, Div. of Union Carbide, now ready to supply roundels, pressed electrodes, and ingots.

On the research side, Horizons, Inc., has an Air Force contract to develop coatings and alloys that will permit the metal to be used at temperatures of 2500 F. (It has a high melting point, and retains strength well, but oxidizes in air above 400 F.) Horizons plans to try cladding, vapor deposition and diffusion techniques.

briefs . . .

Aircraft materials prices are rising—and fast, says the Aircraft Industries Association. Using 1947-1949 as a basis for comparison (1947-1949 average=100), the BLS Consumer Price Index now stands at 121; the Industrial Products Wholesale Price Index at 125.9; and the AIA's own Aircraft Material Wholesale Price Index at a whopping 152.4. "Planes and missiles perform better than they did during World War II," says the AIA "but this is one reason why they cost much more."

Aluminum replaces silver-plated copper cases for GE's 85-C tantalytic and 125-C cylindrical capacitors, bringing a weight reduction of more than 30%. GE says the change does not affect mechanical or electrical properties of the units and the new cases can be used on all types except those containing lithium chloride electrolyte.

Tantalum sheet and fabricated parts will be easier to get from now on. Deliveries have been taking 15 to 18 months, but Fansteel Metallurgical Corp. says it can now meet a 43-week schedule on sheet; 46 to 47 weeks on equipment and tubing. Still further improvement is expected by next Spring as the company's new production plant swings into full operation.

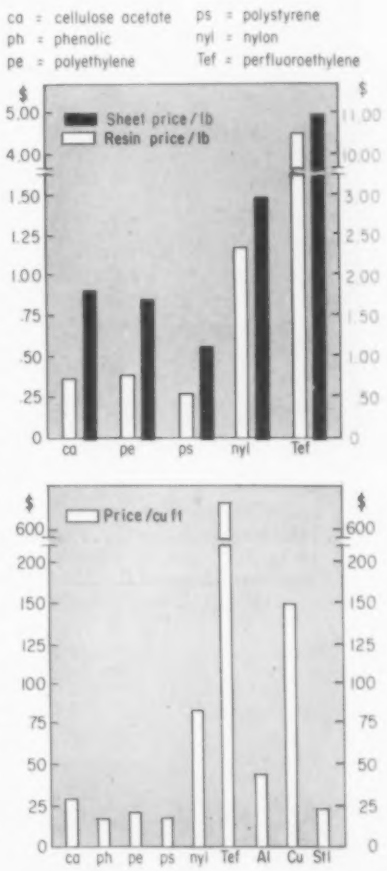
Price reductions are announced for two refractory-metal compounds by Electro Metallurgical Co. Molybdenum disilicide drops 20% (to $12 a lb in quantities of 50 lb or more); and silicon nitride goes down 12½ to 17½%, to a $1.65 minimum. The former may be used for electrical-resistance heating elements, thermocouple protection tubes; the latter for a variety of refractory applications.

High-lead glass with crystal clarity, developed by Corning specifically for high-energy particle counters, may pave the way for better leaded glasses for other atomic and industrial applications. This one has an index of refraction of 1.724, weighs 282 lb per cu ft.

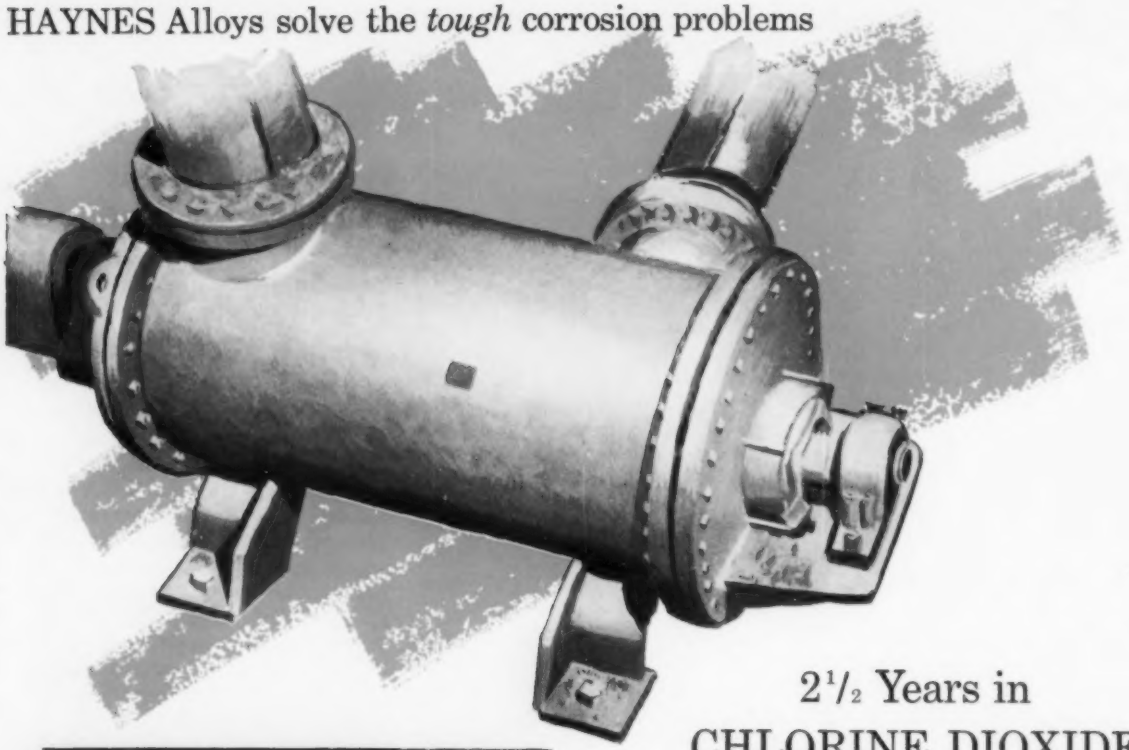
Bright copper plate of higher quality at lower cost is promised by a technique that Metal & Thermit Corp. is introducing. M&T says it's a cyanide process, but uses "an entirely new combination of additives," is easy to control, can be used as undercoat or final finish.

How cost patterns are changing: Plastics

Traditionally, plastics are stable in price—major changes are progressive reductions as new materials move from development to large-scale production. Example: nylon has dropped steadily since its introduction. Recently, though, some lower-cost materials (phenolics, nitrocellulose) have begun to move up in price, reflecting rising costs and general inflationary trends. Rises thus far are only a cent or two a pound—hardly large enough to dictate major changes in resin use—but they do bear watching. Charts below compare basic resin prices with average sheet prices of five major materials, and the volume price (lb/cu ft) of six resins with that of three major metals.



HAYNES Alloys solve the *tough* corrosion problems



2½ Years in CHLORINE DIOXIDE ... and still operating

To give greater brightness to kraft paper, the pulp is bleached with chlorine dioxide (ClO_2). This creates a mixer and equipment problem—some of the mixer materials lasted only six months.

One mixer, lined with ⅛-in. HASTELLOY alloy C sheet, has lasted 2½ years—5 times longer than any previous material used. A mixer made entirely of HASTELLOY alloy C has a full life expectancy of 10 years.

If you have a severe corrosive condition, it will pay you to investigate the use of HASTELLOY alloys. Send for Booklet. Address HAYNES STELLITE COMPANY, Division of Union Carbide Corporation, Kokomo, Indiana.

. . . Process Equipment Protected with HASTELLOY Alloy C . . . can be used to handle acids, fats, oils, or other corrosive materials. This vessel made of HASTELLOY alloy C handles chlorine dioxide used in a pulp bleaching process.

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you can fool SOME of the people . . .

Ever since primitive men began to barter for goods, rather than take them by force, there has been the need for agreement between buyer and seller. Both parties must be satisfied. It takes two to tango.

At times, major suppliers forget this fundamental fact. They become kings of some hill or other and "the king can do no wrong." Pretty soon the big supplier designs as he pleases.

Take the case of Buick: In 1955, Buick astounded observers by selling 781,000 cars, displacing Plymouth as third-largest seller, behind Chevrolet and Ford. Last year, Buick produced 535,000 cars, with no important design changes, while the redesigned Plymouth moved up to third place again and the new Ford challenged Chevrolet.

This year Buick is estimated at 450,000 cars, far out of third place despite extensive restyling. The restyling just didn't catch public fancy, and even though Buick could have produced more cars, Edward T. Ragsdale, division general manager, admits "we just wouldn't have been able to sell them."

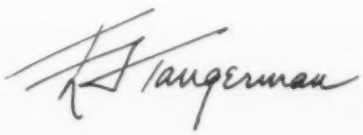
Somebody—or several somebodies—made a mistake.

This example is not unique. Buick has done the same thing before. Chrysler did it with the "Air-flow" design, and was so soundly burned that not until two years ago (and under new top management) did it re-emerge. Ford announced, many years ago, that the black Model T was the ultimate design, and would not be changed. But it was. Today Ford executives predict major design changes every year.

But Ford executives decided to launch the Edsel, a new car as big and complicated and expensive as other American makes, and differing in no notable elements of design. This in the face of skyrocketing public approval of the simpler, smaller, less-expensive and more-economical foreign makes.

Mr. Ragsdale, in discussing Buick's slip, made this further statement: "In a highly competitive field such as ours, success in the market place must be earned, and it must be earned every day of the year. All of us are vulnerable when we are vying for public favor, and can be dislodged from our position at any time."

This statement is worth pondering by any executive of a major company, particularly those having control of design. They might ponder again, too, the hundred-year-old adage credited to Abraham Lincoln: "You can fool *all* of the people *some* of the time, and *some* of the people *all* the time, but you cannot fool *all* of the people *all* the time."



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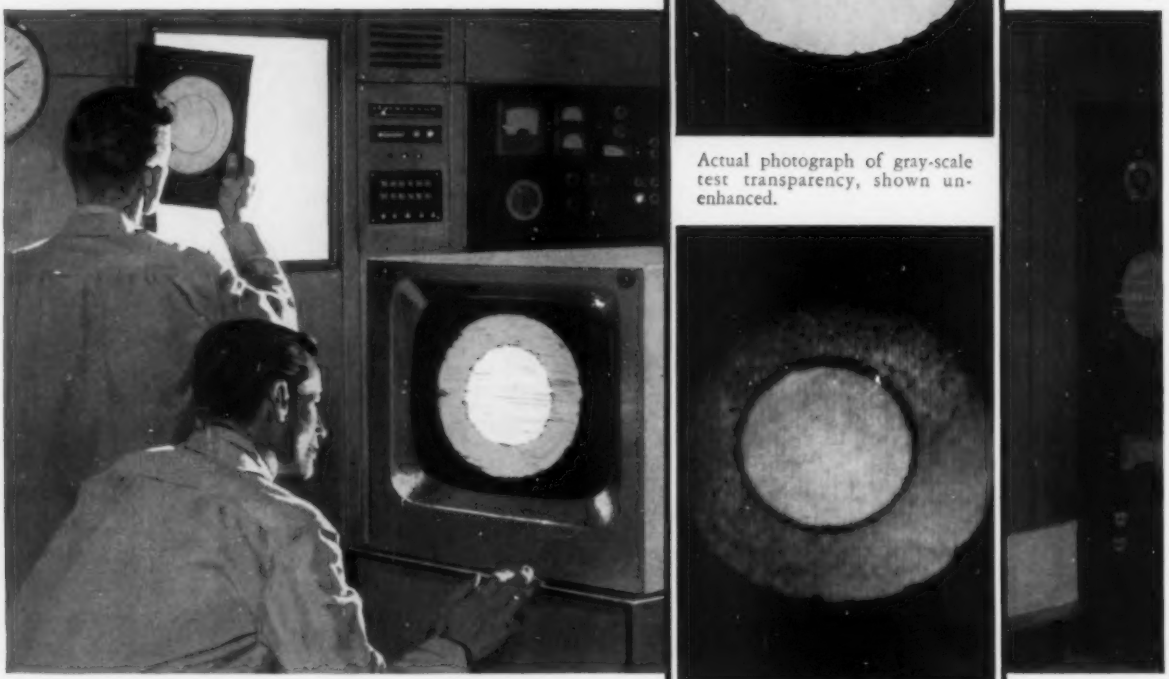

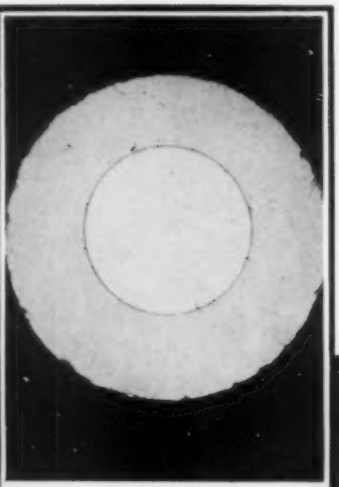

Actual photograph of gray-scale test transparency, shown unenhanced.

The same transparency showing gray-scale contrast enhancement by EXICON.

New Philco EXICON dramatically improves gray-scale contrast on any photographic transparency.

EXICON is proving an invaluable new tool in metallurgy, quality control, stress analysis and countless industrial applications. This new dimension in contrast enhancement is finding application wherever greater detail is desired in the reading of any photographic negative. If you have a problem requiring contrast enhancement . . . Philco's new EXICON system may provide the answer.

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New Product Ideas from the Old World

NEW YORK–Sharp-edged imaginations that cut through research data and tradition to new ideas and ultimately new products are at work everywhere. And many American manufacturers–more perhaps than wish to admit it–are presently turning European and Japanese ideas into profitable products.

The number of new formal programs set up to seek out ideas abroad show extent of American interest:

Armour Research Foundation of Illinois Institute of Technology has enrolled 20 companies in its ETOG (European Technological Observation Group) plan now a year and a half old. Under the program, a team of five Armour technical observers based in The Hague comb Europe for ideas or product leads in mechanical, chemical and electrical engineering, chemistry, and metallurgy. Through foreign scouts, Armour's clients have done three things: arranged an exchange of engineering information with European firms; set up an exchange of products; and gained information on basic research trends that may point the way to new products.

Stanford Research in response to European technical activity in electronics, heavy industry, organic and inorganic chemistry has recently opened an office in Zurich, Switzerland, to scout for ideas. These are funneled back to a dozen noncompeting US clients.

THE POSITION OF US TECHNOLOGY

The flight of American technology into many countries of the free world since the war obscures the two-way flow of R & D. US world-wide technical advance has been impressive. Manufacturers hungering for foreign markets, put out of reach by tariff barriers, currency restrictions and other political barricades have invested many billions in on-the-spot manufacturing facilities.

To date, US firms have invested $33 billion overseas, and last year pumped a record $2.8 billion into foreign operations–almost $700 million of it for manufacturing facilities for automotive products and machinery.

These foreign facilities are turning out the parent company's product line tailored to fit foreign requirements, and are backed by the massive technical and manufacturing know-how of the parent. Many of these foreign manufacturing facilities, a PRODUCT ENGINEERING survey indicates, have their own engineering departments to which the US company freely transmits research data and engineering drawings on proposed new products. Foreign operations constitute a powerful mechanism for the flow of American technical data.

Even where subsidiaries are involved the flow of technology is not always in one direction. Some foreign branches are encouraged to contribute to product design. One company that "furnishes summaries of research progress to major continental associates" reports that by the exchange they have "gained and given valuable ideas on the program of research for fire resistant hydraulic fluids, cutting oils, and several other items.

General Motors has a lively exchange of ideas, proposals and drawings with its European subsidiaries, Opel and Vauxhall, and the exchange produced the 1958 models of those cars. R&D carried on by the subsidiary is available to the parent company.

Many foreign subsidiaries act as sentinels to flag research ideas in Europe and Japan and channel them back to the parent company.

RECENT EUROPEAN ACHIEVEMENTS

PRODUCT ENGINEERING'S overseas correspondents contacted some of the larger European manufacturers for comments on significant technical achievements in their countries. For their comments see following page.

Rand Says Most Product Ideas Bred in US But Born in Europe

One American Scientist, Dr. H. J. Rand, who heads his own research and development firm, feels that American companies are loathe to admit European engineering achievements even though these ideas often lie behind the company's success.

Says Dr. Rand, "Many US companies owe their success to the manufacture of products on a license arrangement with a foreign country. For example, a large US computer and business machine manufacturer has such an arrangement with a French firm. A still larger firm was founded in the early 1900's on the basis of patent arrangements with a German maker of a punched card tabulator. And, a US manufacturer of foamed isocyanates is in business as a result of a joint venture with a German firm.

"Work on the byproducts of coal and petroleum chemistry, which will be the basis of many new plastics, was done in Germany. Many automotive developments, including fluid drive, are of foreign origin. This is true, too, of the basic research on nuclear fission.

"We are ahead in machine tools because we have progressed further into automation. Our high labor costs are responsible for that. However, the theory and basic ideas of servomechanisms and automation came from Europe."

Dr. Rand suggests that US firms interested in product ideas from a foreign country employ a technical representative native to that country. He is apt to be more successful than a man from the US because he knows the language and people. It is difficult to conclude a technical exchange plan swiftly in Europe.

Here are ideas that American manufacturers have taken from Old World sources:

GERMANY

• The electron microscope that uses electron beams instead of light for producing an enlarged image. It is important to virus and metallurgical surface research as well as for organic and inorganic structure analysis.

• Polyvinylchloride magnetic tape, mixed with ferromagnetic iron oxide and introduced in 1943, made it possible to record higher frequencies at reduced speed, permitting storage on magnetic plastic layers for reproduction on TV magnetic tape.

• The first rocket driven rocket plane (and equipped with missiles instead of machine guns), the ME-163, was developed and built by designer-manufacturer Willy Messerschmitt.

• The V-2 guided missile, fueled with ethyl alcohol and liquid oxygen was the forerunner of all modern ballistic missiles. It's mentor, Dr. Wernher Von Braun, has been working in the US since 1946.

• Germany had first jet-propelled aircraft flying in 1939, two years before anybody else. Another first is a submarine air intake called the "Snorkel", now used on many submarines.

NETHERLANDS

• Philips TL fluorescent lamps constantly being improved in an expanding world market.

• Philips ceramic magnetic materials—ferrocube and ferroxplana. Latter opens technical avenues for higher frequencies and computer design.

• Philips double-rotor dryshaver, world's largest exported shaver.

• Radiotelex developed by Dr. Hendrik Van Duuren, chief of Dutch Post Office Laboratories, provides staticless interoceanic transmission. Valued by aircraft personnel.

• Electrodialytic process for desalting water, reduces salt content in water from 5000 to 500 ppm. This was result of eight-nation research program, principally England and Netherlands.

ENGLAND

• Prime post-war development by Britain is the Calder Hall gas-cooled graphite reactor, basis for gigantic $1 billion civil power station program, making nuclear power stations available off-the-shelf. British success springs from decision to concentrate on this type from the beginning.

• Prior to 1950, most important contributions of a development nature were gas turbines and British radar systems. Others include terylene synthetic fiber, invented by R. Winfield of British Calico Printers Assoc. After World War II Imperial Chemical Industries bought world rights outside US where DuPont took it up as Dacron.

• Imperial Chemical Industries also discovered polyethylene, known in Britain as polythene and now the world's best selling plastic. Developed effectively by 1939, polyethylene was indispensable to high frequency wartime radar for planes.

• Roll stabilization of ships made possible by a new system of hydrafoil controls.

SWITZERLAND

IBM lured by Swiss scientific and engineering skill and needing studies on design logic for computers and basic research on components set up a research facility, also in Zurich, last year.

IBM's Swiss facility operates as an integral part of the company's research establishment. Three is a constant interchange of personnel, reports, ideas and discoveries. In addition, Zurich staff members attend significant technical meetings in Europe and maintain contacts with academic and nonprofit research institutes to gain new research leads.

• Resins that can be used for casting and pressing in tool manufacturing are among Swiss developments. Pioneered by CIBA AG, Basle, in 1957, the development was picked up by American manufacturers.

• Sintered aluminum powders, called raffinal 99.99% pure aluminum and superraffinal 99.999% pure aluminum—have been used widely in Europe in transistor manufacturing. They were developed by Aluminum Industrie AG, Zurich.

• Brown Boveri is designing mobile power stations and turbogroups utilizing gas turbines with temperature up to 1400F.

• Abteilung Fuer Industrielle Forschung, Zurich, has developed a broad line of products including a large screen TV system, film scanning system, electron multipliers—picked up by the US—, and ultrasonic watch-cleaning apparatus.

FRANCE

• Citroen has sparked interest of American firms in its hydropneumatic suspension system, introduced in 1954. The company is confident its system will become the accepted method of automotive suspension.

ITALY

• Olivetti Co., Ivrea, Italy, has introduced a mechanical typewriter that spaces letters to size. Spacing between characters and words can be adjusted to provide uniform margins. The mechanical machine is cheaper than its electric counterparts.

• Prof. Natta, Milan Polytechnic, has developed "moplen" a polypropylene whose properties are said to be superior to those of other thermoplastics. It is temperature resistant to 160 F., has greater stress resistance than steel, is a dielectric, and corrosion resistant at high temperatures. The material has a variety of applications.

Electronics for Eye Operations

NEW YORK—Electronic engineers of Ford Instrument Co., working with doctors at New York Hospital-Cornell Medical Center, have developed a new instrument for aiding in delicate eye operations involving detached retinas that is now being used on research animals in an experimental program. Called an Opthalmo-Electrotome, the new device, unlike conventional electro-surgical equipment, enables surgeons to accurately control and measure electrosurgical variables. Close control of electrical power output during delicate operations is important since too much output can result in excessive tissue damage.

Other features of the machine include a simplified tuning procedure that permits the physician to prepare the instrument for operation in less than 10 sec. In addition, an automatic timer inside the machine makes it possible for the operator to automatically set the length of time that radio frequency power is applied to the eye by simple timing circuit controls.

New Building For Engineering Societies by 1960

NEW YORK—Plans for a new $10-million United Engineering Center, to be erected on United Nations Plaza between 47th and 48th Sts., New York, have been announced by Dr. Mervin J. Kelly, president of Bell Telephone Laboratories. Dr. Kelly is serving as chairman of the industrial campaign to raise funds for the center.

The new building, (see artist's concept at left) slated for occupancy in the fall of 1960, will serve as headquarters of 16 national engineering societies with a total membership of about 250,000. It will be a 20-story tower surrounded by lower structures with landscaped grounds and will include the Engineering Societies Library plus exhibition space. Under consideration is a Hall of Fame to perpetuate the contributions of distinguished engineers to modern civilization. In all, there will be about 250,000 ft of floor space. The new structure will replace the present Engineering Societies Building at 29 W. 39th St., New York, now considered inadequate after 50 years occupancy.

Formal announcement of plans for the new structure was made by Dr. Kelly at a recent dinner meeting at the Waldorf-Astoria attended by Hon. Herbert Hoover honory chairman of the fund raising campaign, Alfred P. Sloan, Jr., honorary vice-chairman, and more than 100 leading industrialists and educators. The industry campaign has a goal of $5 million. Members of the engineering societies are expected to contribute $3 million. This money, together with $2 million available in the assets of United Engineering Trustees, Inc., is expected to meet the proposed $10-million cost of the project.

The Talk of the Universe

Above and beyond the normally burgeoning terminology requirements of modern technology is the need for additional vocabulary to serve space-flight engineering.

With this in mind, PRODUCT ENGINEERING asked the American Rocket Society for a skeleton-list of astronautic terms that would show how this branch of technical language is growing:

Astronautics—the science dealing with space flight.

Missile, ballistic—missile that receives a high initial thrust and thereafter continues on its trajectory in free flight.

Missile, cruise—missile powered during most of its flight, usually horizontally.

Missile, guided—missile receiving a low initial thrust. Missile is guided to target by a ground or airborne system in conjunction with corrective propulsion.

Anoxia—loss of oxygen from the blood to the point of fatality.

Apogee—that point on an orbit or trajectory that is the greatest distance from earth.

Beam rider—missile-guidance system where ground system tracks target and missile. Missile is guided along tracking beam to target.

Bipropellant—rocket fuel combination that includes the combustible chemical and the chemical that oxidizes it to make combustion possible.

Burning time—amount of time taken for a rocket fuel to burn out.

Capsule—hermetically sealed container or detachable airplane cabin, used for emergency escape purposes at ultra high altitudes; also used to send animals aloft for experimental purposes.

Drop Camera—special camera in mother ship that photographs sequence of actions of a rocket airplane as it drops away after release from the bomb bay of mother ship.

Explosive decompression—abrupt loss of atmospheric pressure, such as that occurring when a pressurized cabin is punctured at high altitude.

G Suit—protective costume designed so expanding air bladders increase pressure against the body as acceleration increases.

Hypoxia—low oxygen absorption by the blood. Oxygen lack to the point of blackout.

Liquid rocket—a rocket engine that uses liquid chemical fuels for combustion.

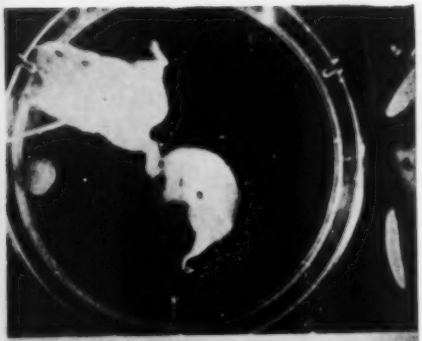
Monopropellant—a chemical rocket fuel of the liquid type that carries within itself the fuel as well as the oxidizer necessary to support combustion.

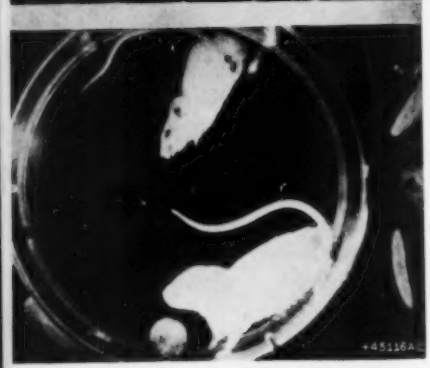
Space rats—USAF slang for the special strains of mice, hamsters, guinea pigs and other small mammals used in upper-atmosphere rocket and balloon research.

Sounding rocket—research rocket carrying instruments to investigate the upper atmosphere.

Telemetering—method of varying radio waves to record pressures, torque, load, temperatures and velocity of an object moving on the ground or in the air. Can also be used to transmit physiological reactions, such as brain waves and pulse rates of mammals in flight.

Free fall—result of inertia. Body (or vehicle) falling through space in one direction at one speed, unhampered by power-thrust.





Design for Living in Outer S

NEW YORK–By keeping a dog alive in space for over a week, the Russians may have given our product designers an important "Go" sign. Sooner now, rather than later, a galaxy of new products will be designed to support space flight by humans.

But product design for space travel will mean a new set of design values. Man, his physiology and psychology, will determine product specs. And complete reliability will be of prime importance.

The engineering that makes space flight successful will lean heavily on physiology. Any container that carries man in space must also carry a reasonable facsimile of his usual environment. Research is gradually closing in on the definition of "reasonable facsimile" and the requirements for vehicle and equipment design.

WHAT CAN MAN STAND?

A human functions through a marvelously integrated system of nerve endings, glands and brain. Nerve endings in the skin sense changes in outside pressures and forces (gravity, for instance) operating on the body. Others communicate between muscle and tissue to adjust body processes to changing external conditions. The precise point at which acceleration, temperature, and pressure changes become too great for the body to adjust, varies with the individual, the duration of stress, and whether survival or efficient functioning is expected.

Of mice and men . . .
and also monkeys. That, in essence, is the pattern of advance into space. These mice traveling as guest of the air force in a rotating plastic drum at high altitudes show what a living creature can take. The monkey in an Aerobee rocket yields data on the effects of high altitude flight on its offspring. This information plus man's reactions in simulated space flight (left) will lead to specifications for cabins in manned satellites.

WHEN YOU CAN'T PLANT FEET FIRMLY ON THE GROUND

Weightlessness may have both physical and psychological effects on passengers. Researchers are giving the conditions considerable attention. It occurs in a satellite when the force of gravity is precisely cancelled by the centrifugal force of the object whirling in space. A "weightless" man feels nothing solid beneath him.

The Air Force has run experiments that indicate weightlessness for very short periods, at least, is not intolerable. Jet planes can attain enough speed to fly a Keplerian trajectory–that is, a course in which gravity force is counteracted by centrifugal force–for 30 to 45 sec. Of the 47 people tested, about half suffered no severe physical or emotional reactions. But more research is needed before we'll know whether a person can tolerate long periods of weightlessness or whether artificial gravity will be necessary.

Handling a human cargo at high speed poses numerous problems. There is a limit to both the linear and angular acceleration that the body can tolerate. People have endured accelerations of 5 to 6 g for short periods, but breathing becomes difficult. Some experts calculate that 3 g is the maximum that a man can endure for more than 3 to 4 minutes. They claim that twisting, turning or tumbling that a rocket might undergo will be intolerable to man. At speeds on earth, a turn of 2 deg. per sec. is barely perceptible to most people unless they have a visual point of reference. But at escape velocity–about 25,000 mph–a turn of that magnitude would exert a 20 g force of angular acceleration, well beyond the estimated human limit.

BOTTLED ATMOSPHERE

Bottling atmosphere in a rocket is another example of how human physiology conflicts with engineering goals. Weight must be minimized. But the passenger must be provided with a gaseous atmosphere. This atmosphere, which exerts strong pressures against

Space—Man and Dog

the emptiness of space, must be contained by the rocket's structure.

The human passenger can survive at pressures far below those at the surface of the earth. Inhabitants of the Peruvian mountains live and work at an altitude where pressure is half that at sea level. Tests indicate that man's mental and physical performance is unimpaired at ½ of sea level pressure for limited periods provided the air is enriched with oxygen. A balance will be struck between man's needs and the efforts to reduce weight.

A human passenger must carry a considerable amount of supporting apparatus to keep himself alive. Dr. Heinz Haber, visiting professor of engineering, University of Calif., estimates a 150-lb man will carry 1000 lb of protective equipment and hardware to get into space and back. It will be necessary, for instance, to carry along equipment to convert the exhaled carbon dioxide into pure oxygen. A chemical absorption system and a system that duplicates nature's have been proposed. The latter uses algae or other plant type to consume carbon dioxide and release oxygen.

The human respiratory and metabolic system creates a humidity problem. Through perspiration and breathing a person releases about 2 oz of water an hr into the atmosphere. This raises the problem of controlling the air's water content. Man will also require apparatus to circulate the air he exhales in gravity-less space. Automatic control over the multitude of factors that simulate an earthly atmosphere in space will require fairly complex instrumentation.

THE ROCKET'S SUN BATH

Human tolerance to temperature is another potential problem for the designer. In high-speed flight through the earth's air wrapping, heat is generated by friction as an object brushes against molecules of air. Beyond about 120 mi altitude the atmosphere becomes so thin heat of friction stops affecting temperature significantly. But the sun-side of the rocket is exposed to the full power of solar radiation and absorbs heat; the shadow side emits heat.

Rate of absorption and emission can be controlled for passenger comfort by various means. Coloring the spaceship to reflect some of the sun's rays has been suggested. Making the ship a flying thermos bottle is another possibility. Space between the metal hull and inner insulating wall of the compartment could be filled with air to conduct radiation into the compartment where it is cool or drained of air to eliminate radiation when it is too warm.

THE ROAD HOME

Some engineers say that recovery of a space vehicle will come about by an extension of high altitude flying. They say best chance of homing a rocket is to glide it in like an airplane rather than carry the fuel to use recoil of rocket motors for brakes. Highest altitude for sustained flight today is around 100,000 ft. This leaves a corridor of several hundred thousand feet in which the atmosphere is too sparse to support an aircraft by present design standards, but dense enough to make heating a serious problem. The higher altitude flight barriers will yield after development of heat-resistant materials, and design with smaller wing loadings and better aerodynamic configurations.

Research on medical problems of space flight may seem premature when monstrous propulsion and metallurgical problems remain before we hurl a manned rocket into space. But some scientists think medical problems the hardest. Britain's Sir George Thompson, who acknowledges difficult technical barriers yet expects to stand in the crowd welcoming home a space traveler, says, "It would not surprise me if the medical problems connected with living in a state of free fall, zero gravity, for many hours on end, prove more troublesome than the mechanics of the flight."

Stapp Sees 3 Bars to Space Flight

HOLLOMAN AFB, N. M.—Three main design problems must be licked before man can travel in space, Col. John P. Stapp, chief of Aero Medical Field Lab, told PRODUCT ENGINEERING this week.

They are insulation, flight configuration, and reentry into earth's atmosphere. To overcome these problems will require application of basic as well as applied research. And solutions will take time and money, he said.

Insulation calls for an air conditioning system that will permit recirculation of cool air. The system will use liquid oxygen to carry heat from compartment walls while allowing for evaporation. This interior insulation has to be coordinated with a strip-flow system of ceramic baffling applied to rocket's outer skin. The baffling would absorb first flow of friction heat on entry into max terrestial altitudes, slowing down flow of air. Flow system is similar to recently announced Lockheed strip-flow system.

Configuration of flight will be dependent on man's ability to survive, both physiologically and psychologically, in space. Progress must be made in design for living up there so flight times can be increased. Negative reaction to acceleration, "weightlessness," and absence of exterior mental stimulation are most important factors.

Reentry into the earth's atmosphere will mean developing efficient guidance system coordinated with effective deceleration devices.

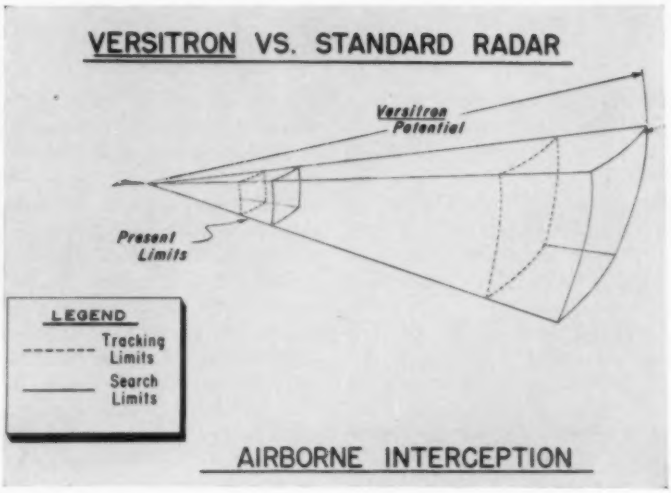
Radar Device Triples Range of Present Systems

CAMBRIDGE, MASS.—An airborne radar device, capable of tripling the range of present day radar, will have immediate application in solving development problems of guided missile controls, antimissile missiles, and general communications.

Designed and built by Advanced Industries Inc., the Versitron, (see photo at right) is a solid-state quantum mechanical amplifying device using energy extracted from electron spin-states in paramagnetic materials.

Using solid-state materials having high-density molecular systems offers higher gain and increased bandwidths. More molecules means that a greater net energy is available for a given structure.

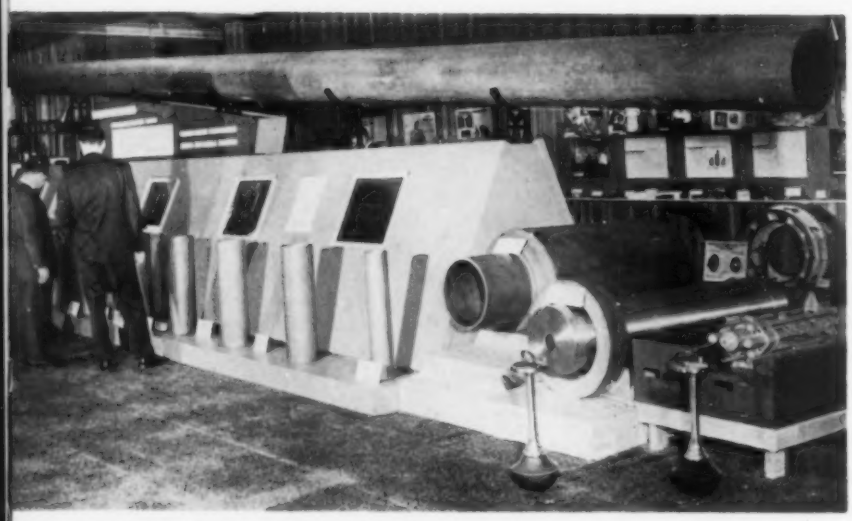
Also, a theoretical comparison of the Versitron and other quantum-mechanical amplifiers demonstrates that Versitron's power capability will be 10^8 greater than that available from molecular-beam systems at microwave frequencies. In addition, Versitron's operating frequencies may be made tunable simply by use of external magnetic fields. Operating frequency of other molecular amplifiers is relatively fixed.



According to Advanced Industries spokesmen, operating characteristics are basically determined by internal molecular configuration rather than by external physical structures, and, therefore, higher sensitivity and higher operating frequencies can be obtained.

Versitron has application in any military radar. Performance improvements can be obtained by using it in the following military applications: bombing and mapping radar, fire-control radars, longe-range scatter communications, ICBM defensive systems including detection, and tracking radars. Effective employment of long range air-to-air missiles can be achieved from present day as well as future higher-speed interceptors.

Reduced sensitivity to electronic counter measures appears a natural by-product. Where existing performance is adequate, or where 3-fold improvement is not necessary, the Versitron will permit reduction in size, weight, power required and complexity.



46 feet in 7 seconds . . .

. . . this length of 16 in. dia. seamless heavywall tubing was extruded from a chrome molybdenum steel billet at Curtiss-Wright's Metal Processing Div. in Buffalo, N. Y. Lengths up to 60 ft., diameters to 20 in, and wall thicknesses formerly available only by forging and machining methods are possible with the new 12,000 ton extrusion press at C-W's plant. Mechanical properties of Grade P11 (ASTM Spec. A-335) tubing reportedly exceed specification requirements by 76% on yield strengths, 25% on tensile strength, 20% on longitudinal elongation, and 60% in elongation in the transverse direction. Heavy walled tubing is also made in stainless steels, high tensile alloys, cupro-nickel and monel.

BITS AND PIECES

A new British prototype submarine propulsion reactor, dubbed "Neptune", expected to play an important part in the design of future British nuclear-powered submarines, is in action at the UK's atomic research center at Harwell. The first reactor at Harwell designed by industry and not government scientists, "Neptune" will be used to study detailed behavior of neutrons in water-moderated core designs with specific reference to a pressurized water reactor for submarine propulsion. . . . A new official report on Britain's much-publicized Windscale explosion points to insufficient temperature instrumentation in the reactor's graphite core as the main cause of the disaster. This led to an incorrect interpretation by physicists of the temperature distribution in the core which was being heated during a routine annealling operation on the graphite. . . .

CORRAL FOR JETS

Air Force test of jet blast fences for installation at US bases has okayed two types of fences: a multiple-vane type and single-vane or (solid) type. Tests of several types of fences were made behind heavy bombardment and jet tanker aircraft. Results are being evaluated, will establish a set of blast fence performance standards for design guidance to aviation industry. . . . A huge 40-ft-long shock tube to test ballistic missile designs at speeds of 13,000 mph is in operation at Lockheed Missile Systems division laboratories at Palo Alto, Calif. Producing shock waves that travel 17 times the speed of sound, the tube is used for developmental investigations on Navy's Plaris ballistic missile. . . . RCA Laboratories scientists report that high-frequency radio signals, bounced from meteor trails 60 to 100 miles above the earth, have been used experimentally for the first time to transmit images of printed material over a distance of nearly 1,000 miles without relays. . . .

High-Thermal Test Unit Keyed to Missile Reentry

Cool now but hot later . . .
The carbon electrodes in this high-termal-flux testing unit can produce an arc hotter than 7700 F. Energy from the arc is focussed on different materials. Purpose: to simulate what will happen to missiles that reenter earth's atmosphere. Southwest Research Institute runs project.

SAN ANTONIO—A high-thermal-flux testing unit in which specimen temperatures have averaged more than 7700 F is being operated at Southwest Research Institute. The facility, sponsored by the National Advisory Committee on Aeronautics, simulates conditions a ballistic missile would meet during reentry into the terrestial atmosphere.

A high-intensity arc is produced by carbon electrodes that do not need water stabilization. By operating in air the electrodes avoid results influenced by water vapor.

A system of parabolic mirrors directs radiant light and heat energy from the arc to the specimen. A specially designed specimen holder permits control of gas and pressure composition.

Scientists of SWRI's Physics Dept. are studying effects of these high-energy concentrations on chemical and physical properties of materials. These effects vary with increased or decreased pressures. The testing unit is encased in a vessel that withstands pressures up to 150 psi.

Specimens are photographed through a port at the end of the vessel with a camera operating at 4000 frames per sec. Temperatures are indicated by a thermocouple activated for a fraction of a sec to avoid melting. Specimens are examined with an electron microscope or X-ray diffraction unit to measure changes.

Cut Glass-fiber Product Costs

Costly layup time of glass-fiber parts is about to be outdated by a new technique that cuts raw-material costs, minimizes air-bubble removal and other time-consuming problems. Heart of the technique, about to be announced by the Rand Development Corp., Cleveland, is a three-way gun that simultaneously shoots glass-fiber, resin and catalyst, giving a stronger, smoother laminate.

Reportedly, 2 men can produce a product as large and complex as a 14-ft, reinforced glass-fiber boat in about half the time usually required. Possible applications of the new technique range from corrugated sheet to tanks for truck bodies.

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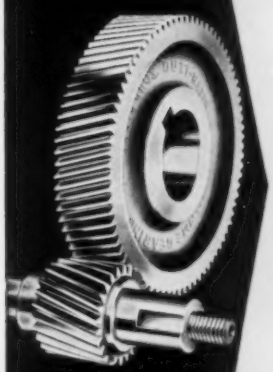

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MIT Boosts Faculty Salaries

INCREASING FACULTY SALARIES has top priority in financial planning at the Massachusetts Institute of Technology, Dr. James R. Killian, Jr., President, said in his recently published annual report.

In order to meet this urgent problem, the Institute is now undertaking to raise at least $5,000,000 to be spent as a "wasting" fund at the rate of one million dollars a year to raise faculty salaries.

Already M.I.T. has raised average faculty salaries by 15% since 1952; in the past two years the Institute provided increased retirement benefits, larger group life insurance coverage, enlarged health and medical services and major medical expense insurance.

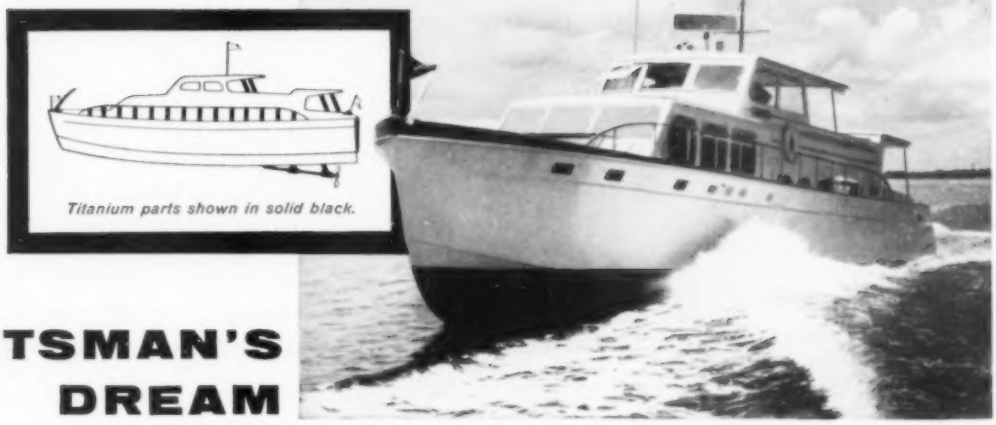
Dr. Killian asserted that there is "acute need" for a group of institutions which set their admissions standards very high. M.I.T. is one of these; its primary responsibility is to put quality first, "to concentrate on the education of high talent."

Electromagnetic-Particle Clutch in French Cars

PARIS—The electromagnetic-particle clutch will be found in the automatic transmissions on two makes of French stock cars in 1958. Price of the optional feature, as announced by Peugeat and Panhard, is $100. This clutch, developed by Jacob Rabinow at the National Bureau of Standards in the late 1940's, has been adapted to automotive use by Jaeger, French manufacturer of dashboard control instruments.

A step-rheostat governed by the accelerator limits energizing of the exciter coil to the amount needed to magnetize the particles to the degree needed for transmitting engine torque corresponding to throttle position.

There is no clutch pedal, and the big advantage is that progressive clutch engagement eliminates shock and vibration. Unlike any fluid transmission, the electromagnetic-particle clutch is 100% efficient at complete solidification. Increased fuel economy of 3-5% was found in cars using this clutch.



YACHTSMAN'S DREAM

salt water corrosion and tarnish banished by TITANIUM

Less heave, more ho! *Titanium anchor weighs only 20 pounds, is a pleasure to handle. It's 44% lighter than its equivalent in steel. Note tubular rail stanchions which are among many titanium parts that require no protection or cleaning to fight corrosion.*

This sixty-foot beauty represents progressive design with corrosion-resistant titanium. Over 300 pounds of finished parts, including propeller shafts, struts, and bearings under the hull; and stanchions, anchor, anchor davit, and other parts abovedeck were fabricated from Mallory-Sharon commercially pure and alloy titanium.

The yacht, the Mystic VIII, built by Huckins Yacht Corporation, will pioneer new marine uses of titanium and document the metal's unequalled resistance to salt water corrosion. Testing has shown that over a thousand years exposure to salt water would reduce the thickness of a titanium sheet less than one-thousandth of an inch!

Titanium's remarkable corrosion resistance pays off in industry too—for process vessels, piping, heat exchangers, and other equipment exposed to severe environments. Titanium is readily fabricated, and available now for non-defense uses. Contact Mallory-Sharon for application assistance and your production requirements.

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION · NILES, OHIO

Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

Listening in . . .
on a vendor, project teams hear him describe his product, process or service. GE seminars have now trained 3000 company men in value analysis objectives and applications.

CATALYST FOR A BETTER PRODUCT

Seminar in Action . . .
gets strangers together fast. Different-colored baseball hats and arm bands distinguish vendors present in advisory capacity. Numbered markers on tables lead vendor to the team working on a specific project.

Engineering, Manufacturing and Purchasing are spurred to work together in GE's value-analysis seminars, reap major benefits in improved product value.

ROBERT E. ABBOTT
Associate Editor

Like other companies, General Electric bumped into problems when products were re-evaluated–mostly human problems. Its successful answer: a catalyst that prods acceptance of value analysis.

This catalyst is the training seminar–a swapping of information and meeting of minds where the value analyst encourages cooperation from Engineering, Manufacturing and Purchasing.

No rarefied atmosphere here. Teams work on genuine "problem children" and, thus far, the three-week get-togethers have never failed to squeeze cost out of a design.

GE specialists even believe that a product could be studied in two successive seminars and the second go-over would give almost as many benefits as did the first. And, in fact, it has been done.

One team worked over a watt-hour meter–already an outstanding engineering design–and offered suggestions adding up to a potential $296,210 annual savings. Another team modified a radar-antenna dipole support to save the Navy $11,571. A vendor attending a seminar recommended cold-heading a spacer stud to reduce cost of an 8¢ screw-machine part. New figure–0.8¢. This is but one example of vendor cooperation.

HOW IT STARTED

Behind GE's program lies its discovery that value analysis, of itself, isn't enough. The company first tried this tool 10 years ago: a one-man study to evaluate products in the light of the many new processes, materials and techniques developed during World War II. It was intended to grow into a three-pronged attack by Engineering, Manufacturing and Purchasing to eliminate any cost that did not contribute to product function or sales value.

The first project saved 30¢ in cost of a control device

Vendors are helpful . . .
with design suggestions. Here, they listen to seminar objectives outlined by Lawrence D. Miles, GE's Value Analysis Service Manager. "Before and After" exhibits (background) show savings—over $1 million yearly—made by analysis teams.

Value of value analysis . . .
is pointed up by old motor screen (spot-welded: $6) compared with result of re-evaluation. It's a one piece job (cost: $1.62) recommended by analysis team at a training seminar.

sold at the rate of 1 million units per year. Annual saving: $300,000—an unqualified success, and well worth repeating. But . . .

Humans are involved. An engineer hates to hear his design is complicated or expensive; manufacturing men get irritated when told they aren't doing their work right; purchasing agents have favorite suppliers and are sure the price is right. Then too, crash programs pressure all three departments into sticking to tried, proved designs and methods.

How can these men find a way to cooperate in re-evaluation? How do you teach cooperation?

Flyers, newsletters and individual talks to department managers helped some. GE wanted more. It set up the seminars; value analysis now saves the company millions each year and seminars train thousands in its use.

HOW IT WORKS

The seminar teams up a man from Engineering, from Purchasing and from Manufacturing for three weeks of intensive training. Each team is supervised by a value-analysis specialist, all set to supply cost information, blue-prints, statistics on product function and behavior, and possibly a sample part.

The teams hear talks by specialists, and by some of the 300 vendors who attend. Each team gets a specific product needing re-evaluation. It may be a motor, washing machine, color TV set.

At seminar's end, participants turn in recommendations and return to their jobs with a new understanding of how value analysis works, why it is used. Most important, they come away with appreciation of what the analyst can do for their own plant.

During the October seminar, for example, teams met and talked with other GE men from 26 departments in 19 cities and one from a company installation in Argentina. They consulted with nearly 300 vendors who were ready to offer specialized experience with their products. Often the vendor can suggest a new and better way to design or manufacture a part—and the purchasing agent often finds a new supplier.

HERE'S THE TEST

Ten Tests for value are taught at the training seminar. They have proved out as money-savers. They are applied to every part, every operation, every material. Here they are:

1. Does it contribute value?
2. Is its cost proportionate to its usefulness?
3. Does it need all of its features?
4. Is there anything better for the intended use?
5. Can a usable part be made by a lower-cost method?
6. Can a standard product be found which will be usable?
7. Is it made on proper tooling—considering quantities used?
8. Do material, reasonable labor, overhead, and profit total its cost?
9. Will another dependable supplier provide it for less?
10. Is anyone buying it for less? Ω

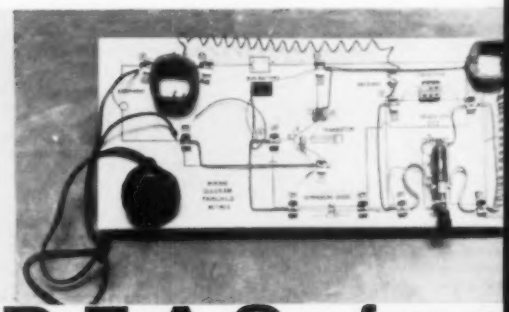
TRENDS in appearance

Engine assembly kit

Transparent-plastic cylinder block permits observation of moving parts and glowing spark-plugs as hand crank is rotated. Retails at less than $25. FAOS

Solar-battery radio

Radio with 100-mi range can be made from kit (under $10) of parts and instructions. FAOS



INGENIOUS IDEAS for

Automatic airliner

Battery-powered airliner "revs up" each motor in turn, then taxis. Remote-control for chair-borne pilots. About $16. FAOS

Autodrome

Lever-arms let players keep racers going at top speed. Develops coordination and is less then $30. Lap recorders raise victory flag on 25th lap. FAOS

New tools for home craftsman

Heavy-duty Porter Cable router (lower right) features motor unit adaptable to several tools. Planer shown (upper right). Safe because Motor unit must be unplugged to change or adjust cutters. Router, under $80.

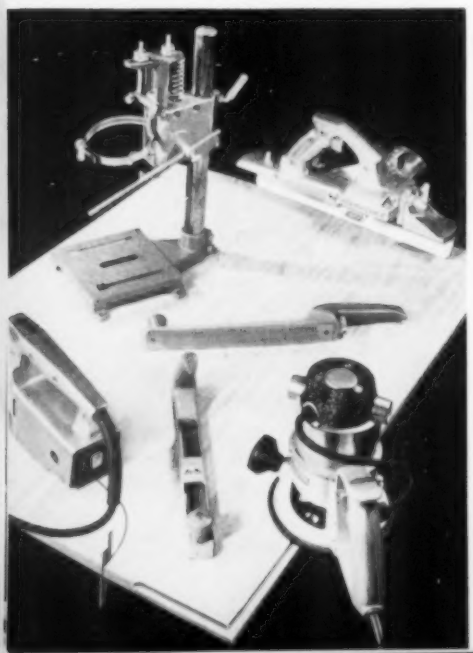
The inexpensive (about $11.00) Babco drillpress stand (center top), usable with any ¼-in. electric drill, has a depth gage and stop.

Heavy-duty sabre saw by Stanley (lower left) cuts wood, metal and plastic; chip-blower keeps work area clear; costs less then $60. Blade shown permits cutting right up to walls and obstructions.

Plane-or-file by Millers Falls (center) is a hand tool priced under $5 for planing or filing wood, plastic or metal. Note two-way handle. All available at PB

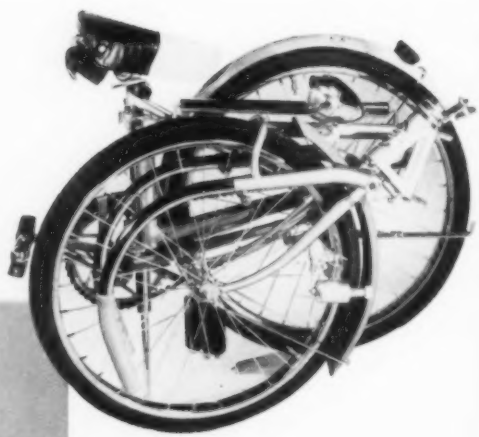
Electric fish scaler

Stainless-steel scaler and plastic shield provide effortless fish scaling for sportsman or housewife. Grinding wheel, buffer and brush sharpen or polish other sports equipment. Approximately $20. A&F



Folding bicycle

Easily folded without tools this 35-lb bike has handle bars and seat adjustable to equivalent of 28-in. wheel-size. Dynamo-powered light, tool bag, tire pump, reflector and horn are standard equipment are all included for around $65. WSE



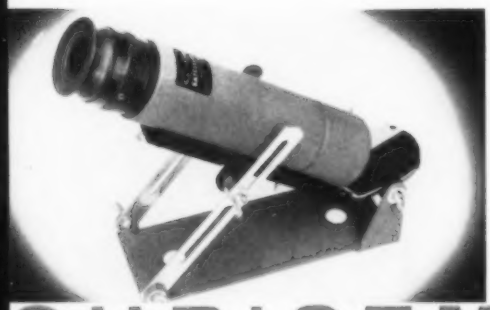
design...

CHRISTMAS

Here are 12 products, suitable for Christmas gifts, that show ingenuity in design and engineering. Suggestions are included for him, for her and for the kids.

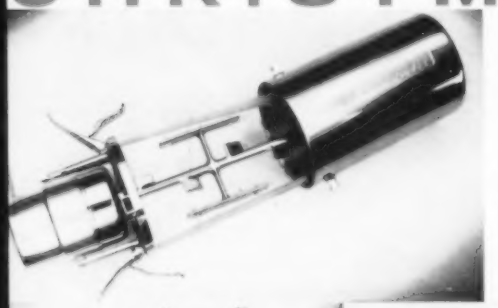
Sources of these gifts are:

FAOS	*F.A.O. Schwarz*	*745-5th Ave., NYC*
ES	*Edmund Scientific*	*101 E. Gloucester Pike, Barrington, N.J.*
A&F	*Abercrombie & Fitch*	*Madison Ave. @ 45th, NYC*
CN	*The Crow's Nest*	*475-5th Ave., NYC*
WSE	*World Service Enterprises*	*1133 Broadway,*
PR	*Patterson Bros.*	*15 Park Row, NYC*



Satellite-tracking telescope

Sputnik-spotter for keeping track of who's who in outer space, available in a $15 and a $50 model. ES



Automatic ice-cream maker

Makes a half-gallon of old-fashioned, paddle-whipped ice cream in refrigerator freezing compartment. Unit (about $35) turns off when freezing is complete. A&F

Bantam outboard

Priced under $150 and weighs 29 lb, unit is made of salt water-resistant materials. Motor delivers 2½ hp to four-bladed, 9-in. propeller that provides excellent thrust. Motor and mount connected by one easily removed pin. A&F

Electric manicure set

Motor-driven, flexible shaft supplies power for nail buffers, sanders, brushes, cuticle pusher (shown attached). About $30. A&F

Collapsible motor scooter

Dependable transportation in a 68-lb package that occupies about 4.5 cu ft, sells at under $200. The 4-cycle, 2¼-hp engine gives 100 mpg. CN

Scientists at recent conference promise new materials for permanent magnets. Among them are challengers to those long-time workhorses, the Alnicos. But problems remain to be solved. Here's an up-to-date report.

WHAT YOU SHOULD KNOW ABOUT NEW MAGNETS

CHARLES J. LYNCH
Assistant Editor

It seems that every time you turn around, someone is announcing a new magnetic material or proposing a new theory and intimating that this is perhaps the last word in magnetics. Phrases like "fine particles" and "crystal structures" are thrown about authoritatively—and still another tradename must be memorized and filed by the overworked engineer.

At the Third National Conference on Magnetism and Magnetic Materials in Washington during the week of Nov. 18 it soon became evident that while much progress is being made, it is nowhere near so startling as some publicity men would have us believe. Recent progress is still mostly on the laboratory benches and in the technical journals.

Although no new permanent-magnet materials were announced this year, researchers disclosed a variety of unusual magnetic effects which may lead to new commercial magnets in the near future. This brings up the pertinent question: How do you judge the excellence of a new magnetic material?

PAR FOR EXCELLENCE

Two permanent-magnet characteristics are of particular interest to the designer: maximum energy product and coercive force. Energy product, a measure of potential energy stored in the material, is the power that can be drawn from the magnet. Coercive force, a measure of the material's resistance to demagnetization, is the opposing field strength necessary to reduce magnetism to zero. The one relates to magnetic strength; the other indicates magnet permanence.

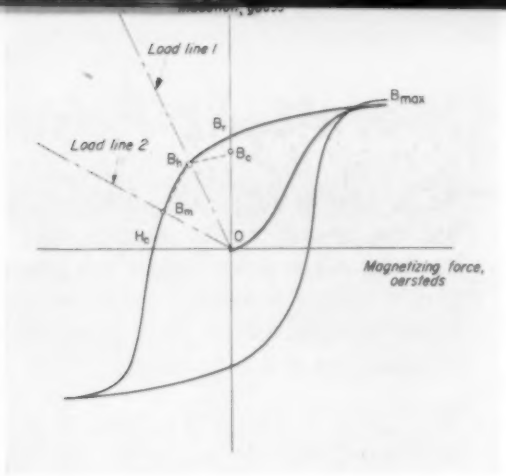
Both high energy product and large coercive force are not usually found in the same material; so compromise is called for. High-energy-product materials will be chosen when high flux density is required within a fixed air gap (as in small motors). Large coercive forces are required where the flux path is short, causing large self-demagnetizing forces, or when the magnet should stay strong despite extensive changes in the magnetic circuit (as in magnetic chucks, gaussmeters etc.) Production of oddly shaped magnets, with north and south poles along the sides rather than at the ends, is made possible by high-coercive-force materials which permit reasonably strong magnetization despite large self-demagnetizing forces imposed by the design.

AVAILABLE MATERIALS

Choice of a magnetic material, of course, does not depend solely on magnetic properties. Cost, physical strength, weight, and machinability may be more decisive. Some materials, the Alnicos for example, cannot be cast in intricate shapes. The ceramics have no mechanical strength and platinum-cobalt, one of the best all-around materials, has very high density and is extremely expensive.

The Alnico family has, for some years, been the workhorse of the permanent magnets. Alnico V has the highest energy product of any presently available material and Alnico VII has high coercive force. However, Alnicos are hard and brittle, and must be ground if close tolerances are required. They are also relatively expensive and mechanically weak.

Theoretical studies indicate that magnetic strength of the Alnico is a result of small, single-domain particles, precipitated throughout the material by metallurgical treatment. Each single domain particle is a very strong "pure" magnet and magnetic strength depends on the alignment of these tiny magnets along



Characteristic properties . . .
of magnet are determined by size and shape of hysteresis loop. Materials with high coercive force have wide, short loops—with high energy product, they have roughly rectangular loops.

A permanent magnet is magnetized by applying a field that drives it from origin (point O) to saturation at B_{max}. When field is relaxed, induction is reduced from B_{max} to a point B_h determined by slope of load line. This slope depends on configuration of magnetic circuit—a short-circuited magnetic path would have a vertical load line.

The major hysteresis loop is irreversible. Changes in the magnetic circuit after magnetization change induction from B_h to B_r along minor reversible loop if circuit is closed, or from B_h to B_m along major irreversible loop if circuit is opened (load line 2, for example).

some preferred axis. Magnetic domains in Alnico are more readily aligned than in other cast materials. However, good alignment requires careful casting and delicate heat treatment.

THE NEW CONTENDERS

The newer permanent magnets are produced by starting with the tiny super-strong single-domain particles. The particles are aligned and dispersed through a nonmagnetic matrix (or binder).

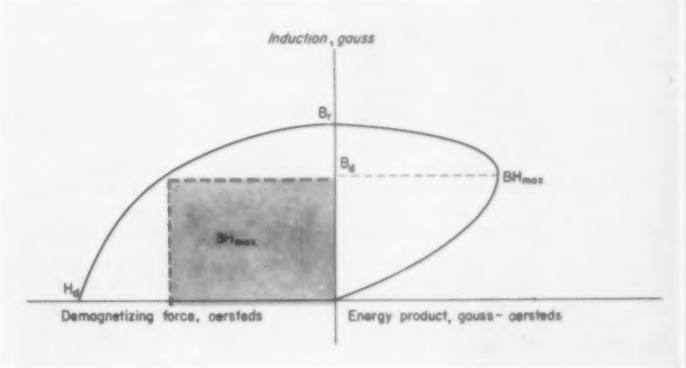
Barium ferrite, for example, has been commercially available for over two years. Because of its similarity to ceramic materials, both in structure and mechanical properties, it is known as a "ceramic" magnet and is marketed under various tradenames (Ferroxdure, Indox, etc.) Its coercive force is higher than a comparable Alnico; it is both lighter and cheaper. Maximum energy product is less than with Alnico V, however.

Manganese bismuth (Bismanol), another fine-particle material, also has high coercive force but commercial production has been delayed by the scarcity of bismuth, loss of magnetic properties at low temperatures, and its poor oxidation resistance.

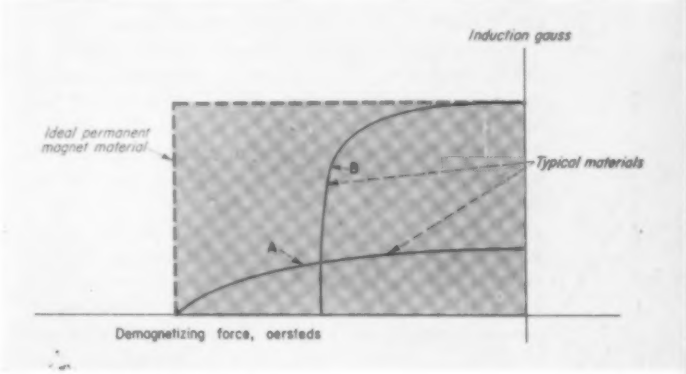
Fine particles of **pure iron or iron cobalt** suspended in a nonmagnetic matrix material may make up the permanent magnet of the future. This material is still in development stage and some problems remain to be solved. In addition to excellent magnet properties, it has amazing versatility. Strength and machinability are dependent upon the nonmagnetic binder. With proper selection of binder it can be soldered, drilled, tapped, machined or cut with a pocket knife. And magnetic properties can be controlled by varying the packing of the fine magnetic particles. A few particles aligned and dispersed in the matrix material show a very high coercive force. Closer packing results in a lower-coercive-force but higher-energy product.

WIDENED APPLICATIONS

The new high-coercive-force materials allow greater flexibility in design and permit applications where permanent magnets have been impractical. Loud-speakers can be made more compact by switching to a high-coercive-force material—its short magnetic length does not impair field strength. Gaussmeters, which measure flux density, may be made more resistant to strong bucking fields. Repulsion magnets, which must operate



Two curves, back to back . . .
show significant magnetic properties for a permanent-magnet material. For convenience, second quadrant of hysteresis loop (demagnetization curve) is combined with energy-product curve *BH* that is plotted against induction in first quadrant. Max energy product may be roughly determined by visualizing largest rectangle that can be drawn under the demagnetization curve. Coercive force H_d residual induction B_r and energy product BH may be read directly from this graph.



Ideal material . . .
for permanent magnet (in color) combines properties of high coercive force material (curve A) and high energy product material (curve B). The square-loop of the ideal has max energy product significantly greater than curve of typical high energy-product material. Recent studies with fine single-domain particles show characteristics approaching ideal.

Some Outstanding Commercial Permanent Magnet Materials

For High-Coercive Force

Material	Coercive force, oersteds	Advantages	Disadvantages
Silmanal	6000	Ductile, malleable, Machinable	Expensive silver alloy Small bars only Low energy product
Platinum-Cobalt	5000	Machinable High BH_{MAX}	Expensive High density
Manganese-Bismuth	3400	Good BH_{MAX} Mechanical properties depend upon binder	Poor oxidation resistance Magnetic properties affected at low temperatures
Barium Ferrite	2000	Lightweight, Inexpensive	Brittle, must be ground
Alnico VII	1000		Brittle, hard, weak

For High Energy Product

Material	Maximum energy product, gauss-oersteds	Advantages	Disadvantages
Alnico V	6×10^6		Brittle, hard, weak
Platinum-Cobalt	6×10^6	Machinable High H_c	Expensive High density
Alnico VI	4×10^6	H_c higher than Alnico V	Brittle, hard, weak

under extreme demagnetizing conditions, also find high-coercive-force materials useful.

Some applications require that the magnet be magnetized before final assembly. This often subjects the magnet to large self-demagnetizing forces when the pole pieces are not in place. High-coercive-force materials can be used here without much loss of magnetic strength.

High-coercive-force ceramic magnets work well as holding magnets. The ceramics are made of inexpensive, nonstrategic materials and require no "leakage gap" to protect them from high self-demagnetizing fields when the magnetic circuit is open. They also have a more gradual change in attraction as the gap between magnet and pole piece changes, making them suitable for cabinet latches, magnetic chucks, and similar retaining applications.

When high-energy materials are required, Alnico V is still the best choice. Electronic applications such as magnetrons find high-energy Alnico V particularly useful. These magnets usually operate at the point of maximum energy product and are designed so that the whole assembly—magnet, pole pieces and magnetic circuit—is magnetized simultaneously.

An ingenious thickness gage uses an Alnico magnet to measure thickness of nonmagnetic coatings on iron or steel surfaces. Leakage flux is measured and found to be directly related to coating thickness. Platinum cobalt, too expensive for most uses, has been successfully used in medical applications for holding false teeth in place, or for attaching artificial eyes to eye muscles.

Permanent magnets are finding increased use in torque transmitting devices—eddy current drives for auto speedometers and hysteresis brakes in tape recorders. Other applications include separators (which snag ferromagnetic trash from materials on a moving convevor), meter movements, toys, and gadgets.

Operations Researc

"We are convinced that our entire management has benefited from our small Operations Research program. I see the results daily in a more realistic and, perhaps, more scientific approach to decisions. There is no way I can estmate the benefits from this change, but over the years it is certainly going to be in the millions."

This opinion is from the vice-president of a company manufacturing electronic equipment. It is characteristic of the many replies to a questionnaire survey on

Who uses Operations Research?

Over half of the responding companies now use O-R. Nearly half of those remaining intend to in the near future. Note that the chemical industry predominates among those now using O-R, second largest group are electrical and electronic manufacturing companies.

Average O-R group size is 6½ persons but the majority of companies have only 3½ per group. Most companies seem to start with 2 or 3 people. As the work is accepted, and grows, group size increases.

Most O-R personnel are engineers (42.3%) though this may be influenced by the predominance of engineers in the aircraft industry. Mathematics (15.6%), statistics (11.4%) and sciences (18.4%) are the other major categories.

These people were, in most companies, taken from other departments in the organization; 111 companies reported that they have active company-operated O-R training programs, 114 used local university classes, and 54 brought in consultants to do the training.

Classification	Company replies	Use O-R	Do not use O-R	
			Intend to	Do not intend to
Aircraft mfg.	23	19	4	0
Chemicals and allied products	115	65	30	20
Electrical machinery & electronic mfg.	83	51	14	18
Food	33	18	8	7
Metals—primary and fabrication	54	25	17	12
Machinery (except electrical)—including motor vehicles	84	44	12	28
Miscellaneous mfg.	94	33	29	32
Utilities	36	17	6	13
Transportation	16	8	6	2
Miscellaneous nonmanufacturing	55	27	11	17
Financial—banks & insurance cos.	32	11	7	14
Totals	631	324	144	163

kes a look at itself

David B. Hertz
Manager, Operations Research
Arthur Andersen & Co.
New York City

Operations Research activity conducted under sponsorship of the American Management Association.

Since 1951, progress in the field of Operations Research has been vigorous, as shown by the results of this survey. Many companies have established their own Operations Research groups, others have consulted outside organizations to attack O-R problems, still others are preparing to use O-R methods in the near future.

To be sure, there is evidence of some scepticism by management as to the ability of O-R personnel to handle difficult industrial problems, but this does not alter the conclusion that management has a real need (and an awareness of the need) to apply scientific principles in decision-making. A president of a transportation company wrote, "We recognize that achieving an understanding of the more difficult problems of management decision-making will involve much effort in the application of the most powerful tools. We are prepared to make such an effort and have faith that the results will make us a stronger company."

This article is based on a paper presented at the American Management Association Conference on Operations Research, Chicago, November 25, 1957.

—— to do what?

So far, production problems have been most heavily attacked, next come sales and marketing, and finally inventory. Most striking figure—the 145 companies attempting long-range problems with O-R.

The aircraft industry (heavy in military-operations analysis of all kinds) has the highest percentage of companies engaged in operations research. Out of 23 firms replying, 19 use O-R, primarily in research and long-range planning.

Over 1000 projects were listed, either by titles or general classes but even these were inadequate in some instances. A chemical manufacturer wrote, "Most of the problems listed are in the formative stage, that is, we are currently engaged in the definition of the problem. In some areas preliminary solutions have been developed—not all of these have been considered from all possible aspects of the corporate operation. To all, however, a scientific approach—utilizing mathematical techniques tempered by judgment and knowledge of the business—has been applied . . ."

and how well has it worked?

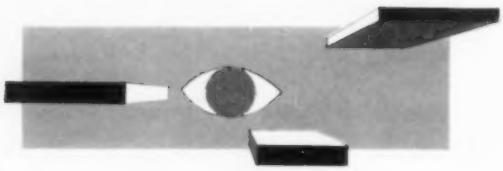
Of the 288 companies that replied, 167 felt is was too early to tell: listed numbers should be judged in this light. Some companies pointed out that immediate problem solution wasn't the objective in setting up the O-R group. The representative of a large chemical company added, "the effort in this company has been directed toward the maintenance of a small O-R group responsible for developing an appreciation of O-R potential throughout the company. It then becomes the responsibility of each organizational unit to acquire or assign professionally trained personnel required for work in the particular unit . . ."

This implies that no short-term savings are expected—yet. But as appreciable savings begin to appear O-R will be taken up by many others now doubtful. "I have recognized a number of problems suitable for O-R treatment," says one engineer. "So far I have not been able to convince top management that it would be worthwhile to start a program. I think we will do so when our competitors have published more results.

-es ing	No. of companies applying operations research to:												Com-panies replying	Results of O-R		
	Produc-tion	Finance	Acc'ntg	Pur-chasing	Top mgt.	Sales & mfg.	Adver-tising	Transp. & shpg.	Inv'ty	Pers.	Rsch.	Long-rg. plg.		Improved operations*	Large savings	Too early
8*	4	4	....	....	9	7	2	2	4	5	10	13	15	7	..	8
4	28	11	14	6	24	26	7	25	27	4	21	26	63	8	16	45
9	31	20	15	18	25	30	2	19	34	5	9	22	46	9	3	34
2	11	4	6	5	9	8	2	7	8	2	7	9	16	7	6	3
4	12	2	4	1	5	10	....	8	13	1	6	9	23	6	4	13
0	25	4	3	6	2	24	1	9	9	6	11	10	40	9	2	28**
9	15	4	5	5	6	12	2	5	13	3	12	11	31	8	4	19
4	5	10	12	2	11	1	....	4	3	7	1	13	13	8	4	3
7	3	5	2	1	6	4	1	6	2	5	2	7	8	4	3	4
3	17	19	5	3	14	14	3	9	20	8	6	19	24	9	9	6
9	1	4	6	3	1	....	....	1	2	2	5	6	9	2	4	4
1	152	87	72	50	92	136	20	95	135	48	90	145	288	75	55	167

te: This was a multiple-choice question, thus row sums do not total number of companies replying.
All aircraft companies reported doing military operations analysis, as did some others.

** There were duplicate answers, thus row sums may not equal companies replying.*
*** One listed results as "satisfactory."*



POINTS

WORLD-WIDE ANSWERS TO THE QUESTION:

"What is the relationship between the chief engineer and the head of the production department?"

"A design engineer scarcity exists . . .

in the Italian machine-tool field. Up to five years ago there was little original machine-tool design in this country, and as yet we have no Italian institute offering formal preparation in the field. This, of course, places a premium on the competent designer—reflected both in pay and community prestige. Our present director of design came to us over 10 years ago from an aircraft firm where he specialized in hydraulic systems. While our director of production must have a thorough technical know-how, he need not have an advanced academic training in the profession.

"We endeavor to maintain the closest cooperation between the design and production directors. Normally both men meet daily to check and guide product development, once prototype assembly has begun. This joint work continues through to the final testing of production models. We also encourage close cooperation even during the initial drawing-board phase. Both the design and production directors confer regularly with the company commercial representatives, the suppliers and customers."

DR. GIULIO ZANETTI
General Director of O.M.O. Tool div. of Olivetti Co., Ivrea, Italy

SHIGEKI TASHIRO
Board Chairman
Toyo Rayon Co. Ltd.
Tokyo, Japan

"We have no chief engineer . . .

as such. We are divided into three divisions: Administration, Business (sales), and Production—each under a managing director. The managing director in charge of production happens to be an engineer, though this isn't a requisite for the position. However, his assistant, also a director, must be an engineer. He works closely with the plant manager of each of our six plants and with the chiefs of our technical departments for rayon, synthetic fibre, plant construction, etc.

"In each plant, there is a chief of production who is directly responsible to the plant manager. Thus, unlike the technical department chief, the plant production head does not deal directly with the company production division.

"Before the war, things were a little different. People in technical fields, it was thought, were too limited in their vision to make good administrators or policy makers. Thus, engineers were not quite in the same social stratum as the administrators. Such thinking still exists in Japan, but as you can see from my company's example, this conception is no longer too widespread."

OF VIEW

"Vice-presidents head Engineering and Production . . .

in the Atlas Copco organization. They have much the same position and both have a technical university background, though, of course, their experience is different. Engineering is mainly concerned with the application of compressed-air-driven equipment to customers' industrial activities. Production's main interest is machine-shop problems. A very close collaboration between Engineering and Production is essential and several organization arrangements have been made to create and maintain such collaboration on all levels."

ERIK RYD
Atlas Copco—Compressed Air Equipment
Technical Manager
Stockholm, Sweden

F. H. FARMER
Asst. General Manager
Standard Eletrica S. A.
(Mfg. Telecommunications equipment)
Rio de Janeiro, Brazil

"Emphasis is initially on production . . .

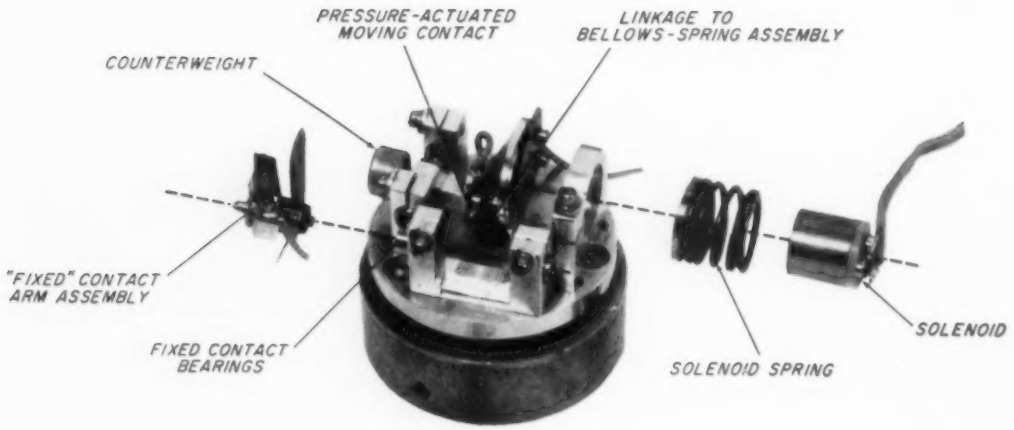
of products which have been previously developed and manufactured in other countries. Consequently, engineering of the product is largely a matter of maintaining quality and adapting locally available materials and components. In these circumstances, Engineering is subordinated to the production manager, who has the main responsibility for turning out a satisfactory product. It is not foreseen, however, that this organization arrangement will be permanent. With increasing local industrial development and a larger demand for local products made with local materials, the need for something more than adaptive engineering is beginning to be felt. There is no doubt that our company will have a chief engineer within a relatively short time who will be on the same organization level as the production manager and who can assume full responsibility for product development."

"We use no titles . . .

in the company which my son and I manage, nor do we block ourselves against visitors by ante-rooms. All executive employes including the chief engineer and the head of the production department are at the same level and report only to the company management. Teamwork, human relations, and confidence in each other are considered of special importance. However, the importance of the chief engineer weighs somewhat heavier than that of the head of the production department. Both are engineers as far as educational background is concerned, but the chief engineer represents the creative power and it is his skill and ideas that decide primarily the success or failure of a product and its future chances on the market. Since a good chief engineer must additionally have a first-class sense for production techniques, it goes without saying that his influence on the end-product carries special weight."

HANS GLAS
Manager & Part Owner, Hans Glas GMBH
(Mfg. the baby car, Goggomobile)
Bonn, Germany

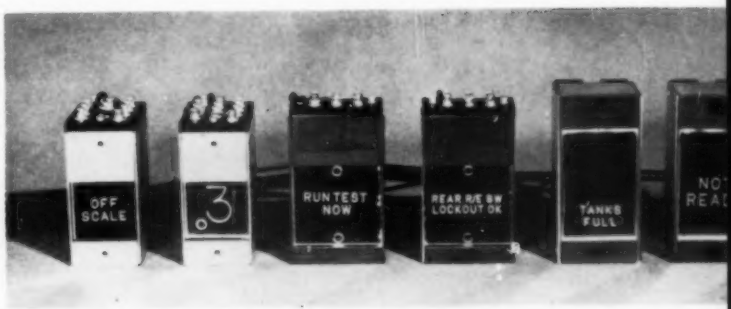
SIGNIFICANT PARTS



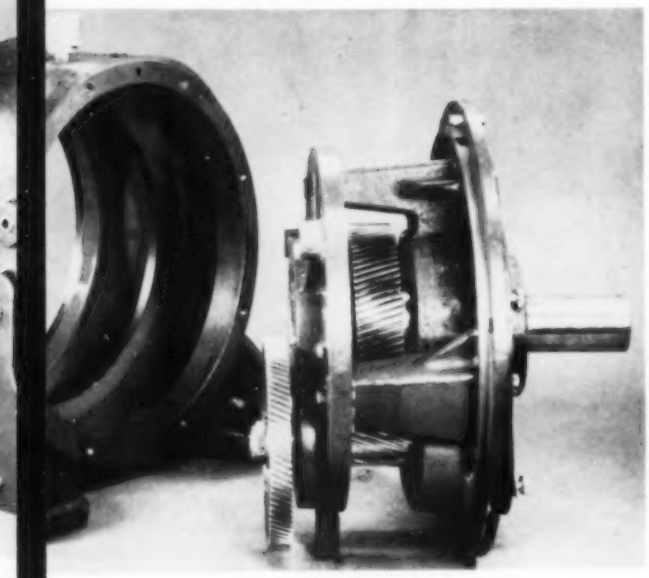
Pressure switch can be remotely calibrated . . . and requires no servo system. It will turn a flow on or off as pressure exceeds or falls below a set point, and can also be used where other variables must be controlled. One of its two contacts is automatically 'fixed' by application of desired pressure. Second contact is secured to a ball-bearing-mounted arm and moved by a bellows-spring assembly in accordance with pressure changes. Range is 0 to 15 psia, accuracy about 0.003%, size, 2 x 2 7/16 in. Unit operates on batteries or 110-v source and requires a 1-amp-resistive switching circuit. Price, $485; delivery 60 to 90 days. **Trans-Sonics, Inc., Burlington, Mass.**

Objects in motion . . . can be studied with this variable-frequency stroboscopic light source, calibrated from 10 to 100 pulses per sec. An output is provided to drive a counter. Net price, $70. **Northeast Electronics Corp., Municipal Airport Bldg., Concord, N. H.**

Lighted, color-coded messages . . . are provided by a line of readouts. Lighted digits zero through nine and decimal point are available, as well as polarity signs or special symbols. Readouts will display, separately and in one panel area, up to three color-coded printed messages. Message and color combinations are made to suit requirements. Modular design allows side-by-side mounting of units. Designed for operation on 6, 14, or 28 v. Prices range from $11.50 to $19.50; immediate delivery. **Milman Eng. Co., 1831 Pontius Ave., Los Angeles 25.**



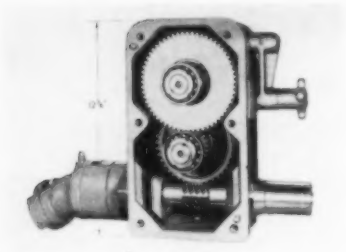
MATERIALS · EQUIPMENT



Speed reducer gears can be interchanged . . .
to handle wider range of ratios, 5:1 to 625:1, with loads up to 30 hp. Heat-treated and ground helical gears are mounted on rolled spline shafts. Sprockets, pinions or pulleys can be used for take-offs, and manufacturer claims extra overhung load capacity. First three models in seven-unit series available by first of year. Prices comparable with previous speed-reducer line. **Westinghouse Electric Corp., Box 2278, Pittsburgh, Penna.**

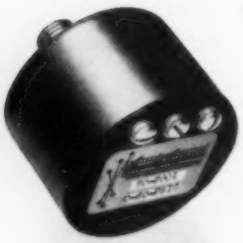
Self-locking, leak-resistant nut for adjustment . . .
of flow, electrical contact, spring pressure and other factors. Shaft (in illustration, used for carburetor needle valve) threads itself into neoprene insert. Tests are said to show no leakage after more than 10,000 on-off cycles, and sufficient torque remained to maintain adjustment required. Manufactured with 8/36 internal thread and $\frac{3}{8}$-24 external thread. Price, under 5¢ in production quantities; immediate delivery of unit shown. **Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.**

Hard surfacing supplied on flexible backing . . .
is made of hexagonal plates of cemented tungsten carbide. The glass-fiber sheet or strip backing holds surfacing in position during epoxy-bonding, soldering or brazing of this continuous hard surfacing to flat, odd-shaped or rounded contours. The larger plates are 0.425 in. across and are commercially available in $\frac{1}{8}$, $\frac{1}{8}$ and $\frac{1}{4}$-in.-thicknesses; 0.210-in. plates come in $\frac{1}{16}$ and $\frac{1}{4}$-in. Normal joint spaces are said to be less than 0.002 or 0.003 in. Strips 6 and 12 in. long are commercially available, in widths 0.65 to 5.95 in., depending on thickness. Price is 40¢ to $2.25/sq in., depending on size and thickness of the elements used. **Kennametal, Inc., Latrobe, Penna.**



Two-speed gear box . . .

can be used with hydraulic or electric motors. Hardened and ground worm and bronze worm wheel are standard Boston design. Worm and wheel are available with one to four threads, depending on speed range desired. Used with two sets of shaved, heat-treated steel spur gears. Spring-loaded indexing handle selects neutral, 1:1 or 3:1 ratio. Equipped with tachometer feedback for speed control. Aluminum housing has helical, stainless steel inserts in all threaded holes. **Tracer Control Co., 595 E. Ten Mile Rd., Hazel Park, Mich.**

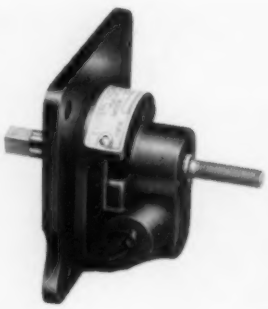


Pneumatic transmitters . . .

convert fluid pressure inputs to electrical equivalents. High-level signals may be used without amplification in control, telemetering or remote recording circuits. In five standard ranges, from between 0 to 15 psig and 0 to 200 psig. Measures 2¼ in. dia x 1¾ in. deep. **Computer Components Div., International Resistance Co., 401 N. Broad St., Philadelphia 8.**

Rapid, high-strength bonds . . .

between many materials can be formed with this monomer-based adhesive. It sets within seconds generally, without use of heat, excessive pressure or catalysts. It is a cyanoacrylate monomer modified with a thickening agent and plasticizer. Chemical solidifying action takes place without appreciable change in volume. Glass-to-glass bonds are unbreakable within 5 to 15 sec; wood-to-wood bonds require 3 to 5 min to set; steel-to-steel bonds set in 15 to 20 sec and develop 2000 psi tensile strength within 30 min and 5000 psi after 48 hr. Exposure to temperature above 212 F for more than 24 hr and to water at temperatures near the boiling point will destroy the bond. Exposure to water below 170 F for prolonged periods will weaken the bond, but not drastically nor permanently. In limited production, 1 oz sample kits are available at $5 each. **Eastman Chemical Products, Inc., Kingsport, Tenn.**

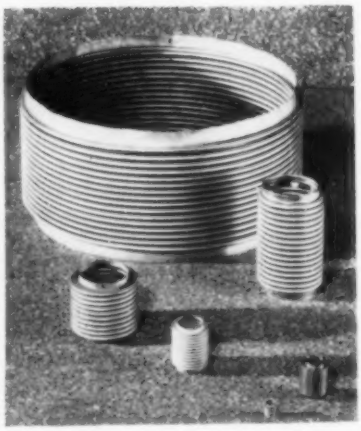


Pump supplies oil . . .

at a continuous rate through a hollow shaft at regulated pressure of 100 psig (±5) over a speed range of 1500 to 3750 rpm. Originally designed to lubricate bearing of airborne 3000-psi air compressor, the pump now is in large-scale production. Can satisfy demands of 0.3 gpm. A fan mounted on the threaded end of shaft cools compressor. Thrust and radial unbalance loads of fan are carried by special pump bearings. Max dimensions are 3 x 3$\frac{3}{32}$ x 3$\frac{13}{16}$ in. Weight is 10 oz. **Eastern Industries, Inc., 100 Skiff St., Hamden, Conn.**

High-strength metal . . .

combines best properties of austenitic manganese steel and martensitic white irons. Can be cast in all forms and shapes. No strategic materials are required. Structure is similar to heat-treated steel and possesses a better combination of hardness, strength and resistance to impact than either austenitic manganese steel or martensitic white irons. Certain types have tensile strengths of 90,000 psi with ductility of about 15%. It can be machined, with difficulty, using carbide-tipped tools. For use wherever exceptional wear resistance and hardness are required. **Meehanite Metal Corp., 714 North Ave., New Rochelle, N. Y.**



Nickel-chromium bellows . . .

to meet high-pressure and high-temperature applications to 1500 F have been developed in sizes from $\frac{1}{32}$ in. to 12 in. OD and in single to four plies. Smaller sizes are seamless; larger bellows are welded. Inconel, the nickel-chromium alloy, is an age-hardening material said to have stability where a precise response must be repeated many times over an extended period. A four-ply Inconel bellows with 2-in. OD is capable of withstanding 1000 psi at room temperature. **Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville, Tenn.**

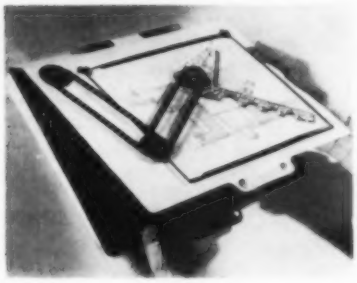
Hot-melt adhesive . . .

is said to take an instantaneous hold on most materials. It has been used in assembly-line operations to hold parts in place until they can be fastened permanently. May also be used as a permanent binder in applications where temperatures do not exceed 150 F. Lap joint of 1 sq in. made from strips of Mylar will hold a dead load of 50 lb at 73 F and a load of 6 lb at 150 F. Composed entirely of solids, the adhesive is supplied in a semi-brittle state and liquefied by heating to 250 F. It is applied in the fluid state to one of the parts to be assembled and pressed into contact with the other until adhesive cools. May be kept at 250 F without deteriorating. **Raybestos-Manhattan, Inc., Bridgeport 2, Conn.**

Four-way slide valve . . .

actuates a variety of pneumatic mechanisms and equipment, and is designed with interlock switch and manual setup control. Can be used to obtain reciprocating action of double-acting cylinders with long or short stroke. The unit,

which can control more than one mechanism, is used, for example, to control parts escapement and also positioning action in high-output assembly operations. Includes a pilot-operated slide valve, remote return control throttling valve, electrical junction box with provision for air silencer and 110-v electric or pneumatic initiation. Outside dimensions are 3 x 2 x 6⅞ in. high, including solenoid pilot valve. Mounts on or adjacent to a power head. **Dixon Automatic Tool, Inc., 2300 23rd Ave., Rockford, Ill.**



Portable drafting machine . . .

permits engineers, designers and architects to make accurate drawings on the spot, instead of free-hand sketches. Unit combines drawing board, T-square, triangle, hole-and-radii template, compass and protractor. It will remain true at any setting over the complete area of 8½ x 11-in. drawing sheet. Enclosed in a briefcase folder equipped with closure snaps. Can be used flat or at an 8° angle. Top cover provides a pocket for storage and paper supply. Case is available in blue, brown, burgundy and white. Price is $15.50. **D. W. Price Corp., 11161 W. Peco Blvd., Los Angeles 64.**

Prototypes and low-production items . . .

can be produced more economically using this special polyester compound that contains inert filler pigments and milled glass for molds or dies. It is either poured into an open mold for encapsulating or injected into a matched metal or plastic die. Parts are reported to be equivalent in many respects to cast or molded phenolics. Molds and dies can be made from cast alloys, plastic, plaster, ceramics and other materials. Color is neutral, but pigment paste can be added. **Western Tool & Mfg. Co., Springfield, Ohio.**

Save time and money in your engineering department and on the assembly line. The inverter illustrated is one example of ERIE's ability to produce subassemblies.

ERIE has integrated facilities for producing electronic components, molded plastic parts, metal stampings, and printed wiring boards. Automated facilities for assembling and soldering assure low cost production. ERIE's financial soundness and proven reputation for quality provides an ideal source of supply for your Electro-Mechanical assemblies.

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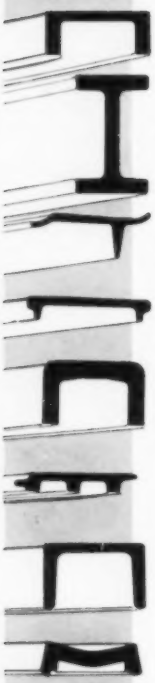

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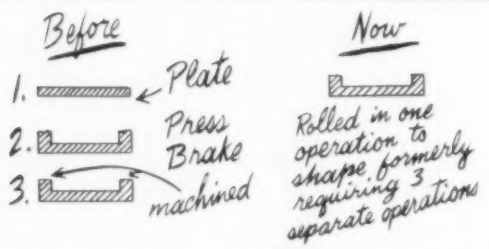
- Designed to your own specifications and tolerances, when your tonnage requirements justify special rolls
- Free Engineering Consultant Service!

An example of how Connors Special Sections save time and money . . . yet assure you of ultimate strength:



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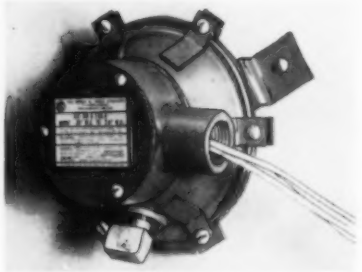
H. K. PORTER COMPANY, INC.
CONNORS STEEL DIVISION

SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .



Control senses pressures . . .

or vacuums of 0.05 to 40 in. water column. Available in three diaphragm sizes. Pressure settings are adjustable by a screw for field setting. Fixed on-off differentials ranging from 0.05 in. to 4 in. water column, depending upon diaphragm sizes, are obtainable. Vacuum connection is only usable with air or inert gases. Controls have dust-tight, splash-proof switch housing. Electric ratings of SPDT contacts are 15 amp at 120 to 250 v ac, ½ hp or 125 v-amp pilot duty. For best operation, the switch should be mounted on a vertical surface. **Henry G. Dietz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.**

Silica glass tubing . . .

resists extreme temperature changes and will not react to other materials. ID tolerances can be held to 0.0005 in. Tubing can be manufactured with bores from ⅛ to 3 in. dia. Max length of the tubing presently is 36 in. Special slots or indentations inside tubing can be made with precision tolerances. This glass tubing has low coefficient of expansion, 0.0000008 in/in./C. **Corning Glass Works, Corning, N. Y.**

High-accuracy thermometer . . .

has a new sensing probe. Available with probe mounted on the end of a 30-in. flexible cable or with probe mounted integrally on rear surface of indicating instrument. Recommended for use on reasonably clean metal or other surfaces. Sensing element of probe is spring-loaded between two projecting lips. Accuracies of 5% on all ranges and indication of two-thirds of ultimate temperature in less than 1 sec are achieved, according to the manufacturer. Scales, calibrated in both Fahrenheit and Centigrade, are available in four ranges: 0 to 300, 0 to 450, 0 to 650 and 0 to 100 F for the remote probe style. **Royco Instruments, 722 Arthur St., Albany 10, Calif.**

Shock-free valves . . .

adaptable for remote control, are designed for working pressures to 150 psi, temperatures to 150 F. Developed primarily to protect lines, pumps and other equipment against damage from shutoff shock. Control is by an internal pilot valve that can be actuated by solenoid, hydraulic or air cylinder, or direct manual control. Line valve consists of a spring-loaded valve-piston, seat and cylinder assembly. The spring holds valve closed in absence of line pressure, presence of back pressure, or when pilot valve is turned to allow upstream pressure to flow behind piston to balance upstream pressure. Rate of closing is adjustable. Sizes are available for 3 to 10-in. oil, water or gas lines. **Ralph N. Brodie Co., San Leandro, Calif.**

Interval timers . . .

use basic, repeat-cycle timer construction with switching system that allows high accuracy over long-range timing intervals. Available with chronometrically governed dc motors or synchronous ac motors. Accuracy is said to be 1% or better. Range of adjustment is determined by application requirements. Designed for panel mounting. A hermetically-sealed adjusting knob on the front of the unit allows setting of calibrated dials within the glass window. A double dial is used: one dial shows major setting increments, the other is a vernier adjustment of these increments. Design eliminates clutching system and requires no standby power when unit is timed-out. Mounting flange is 6⅛ in. x 3¼ in. **A. W. Haydon Co., Waterbury, Conn.**

Self-lubricating material . . .

outwears steel 60:1, and can be cast without heat or pressure. It has been used successfully as guides on textile machinery, low-speed bearings, building up surfaces subject to severe wear, making duplicating masters and forming-dies. Has good resistance to most acids, alkalies, solvents and other chemicals. Packaged in paste form. Shrinkage of a 4 x 3 x 1-in. block is 0.0002/in. Supplied in 1, 4 and 15-lb containers. Trial kit of four 1-lb cans and necessary components sells for $11.40. **Devcon Corp., Danvers, Mass.**

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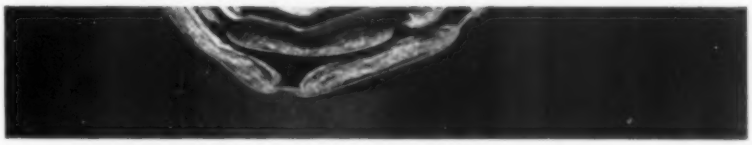
Low-Cost Backing Material Cuts Upholstery and Backing Costs

FELTERS ALLFAB



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1-6 **ASME Annual Meeting,** Sheraton McAlpin and Statler Hotels, NYC. Schedules call for 12 to 15 simultaneous sessions to allow broad and specialized coverage of engineering developments. For information contact the Society, 29 W. 39th St., NYC.

2-6 **26th Exposition of the Chemical Industries,** New York Coliseum, NYC. Showing of latest developments in the production and use of chemical substances. For information contact E. K. Stevens, 480 Lexington Ave., NYC.

2-6 **3rd International Automation Exposition,** New York Trade Show Building, NYC. For information contact Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh, Penna.

5-6 **Industrial Productivity Conference,** 12th annual session at Illinois Institute of Technology. Purpose is to encourage increased productivity through discussion of improved engineering tools and techniques. For further information contact LeRoy Wickstrom, Technology Center, Chicago, 16.

9-13 **Joint Computer Conference, and Exhibit** sponsored by AIEE, IRE, and ACM, Shoreham and Sheraton Park Hotels, Washington, D. C. Agenda covers use of "electronic brains" for defense, industry, aircraft, earth satellites, automobile control, communications and business. For information contact AIEE, 29 W. 39th St., NYC.

10-11 **Society of the Plastics Industry,** session of the Plastics Film, Sheeting, and Coated Fabrics Division, Hotel Commodore, NYC. Conference theme: Quality Vinyl Products in the Consumer Field. For information contact J. Roy Price, Bakelite Div., Union Carbide Corp., NYC.

13-14 **International Cybernetics Association Conference,** Namur, Belgium. Conference theme, Economic and Social Implications of Automation. For information contact George Boulanger, International Cybernetics Association, Nr. 18, Dreve des Wegerias, Boitsfort, Brussels, Belgium.

18-19 **Maintainability of Electronic Equipment,** Conference of the Electronics Industries Association, Bovard Hall, University of Southern Calif., Los Angeles. Sessions cover new concepts of maintainability problem, and design of equipment for easy maintenance. For information contact EIA, 11 W. 42nd St., NYC.

JAN.

6-8 **Symposium on Reliability and Quality Control,** sponsored jointly by the AIEE, RETMA, IRE, and American Society for quality control. Hotel Statler, Washington, D. C. Includes 40 papers by industrial, government, and military authors. For information contact AIEE, 29 W. 39th St., NYC.

28-30 **Midwest Welding Conference,** sponsored by Armour Research and Illinois Institute of Technology, and Chicago section American Welding Society, at Chicago. For information contact Harry Schwartzbart, 10 W. 35th St., Chicago 16.

FEB.

4-6 **Society of the Plastics Industry,** Reinforced Plastics Division, technical and management conference, Edgewater Beach Hotel, Chicago. For information contact the Society, 67 W. 44th St., NYC.

WHAT THEY SAY . . .

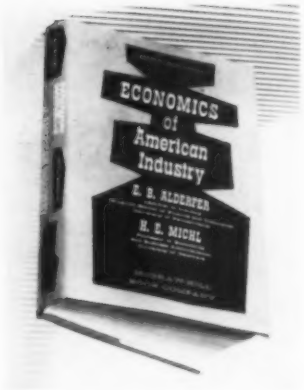
MARK W. CRESAP, JR.,
executive vice president of Westinghouse, warning electrical industry leaders at Atlantic City: "Face the economic facts of life and receive fair prices for your products if you want to support your research and other expansion programs—essential to realizing your remarkable potential."

PRIME MINISTER NOBUSUKE KISHI,
commenting in Tokyo on Pres. Eisenhower's suggestion to share the scientific wealth: "We have received no concrete approach on this subject . . . but as a general principle we feel that Japan should not allow her scientific technology to be used for military purposes." (See p. 111, Nov. 25, '57)

CLYDE C. SCOTT,
systems engineer of Minneapolis-Honeywell's Brown Instruments Div., advising instrumentation industry leaders in N. Y. of problems posed by atomic reactors: "Most serious are the matters of corrosion and radioactivity. Measuring elements for power reactors and their cooling systems must be heavily shielded, require special materials and must be designed to operate for lengthy periods without maintenance. These problems are a worthy challenge to your industry."

DR. GEORGE HUFF,
Callery Chemical Corp. research director, revealing to newsmen in Pittsburgh that his company has been producing pilot-plant quantities of boron-hydrogen high-energy fuel for quite some time: "By next spring we'll be producing HE fuels in substantial quantities in our new $4-million plant at Lawrenceburg, Kan., and even more at our $38-million plant in Muskogee, Okla., starting Jan., 1959.

HENRY HAUSNER,
vice pres., Nuclear Engineering Div., Penn-Texas Corp., advising the American Ordnance Association at Joliet Arsenal, Ill.: metallurgy behind the Iron Curtain is highly developed, and in USSR is at least at same stage as in US."



NEW LITERATURE

Economics of American Industry

E. B. ALDERFER, *Wharton School of Finance and Commerce*, and H. E. MICHL, *U. of Delaware. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. Third edition, 6½ x 9¼ in., 710 pp. $7.00.*

This is a complete revision of a basic text used in colleges throughout the country as an introductory survey of the principal manufacturing industries in the U.S. It can be recommended as a reference book for those needing a detailed yet brief look at one or more of the seven industrial complexes included: metal production, metal fabricating, non-metallic minerals, chemical processing, textiles, apparel, food-liquor-tobacco.

Each industry is analyzed and its role in American society and economy described. Organization, principal characteristics, products, technology, geography and history are discussed.

Most readers of this volume will probably feel that one or another of the industries included as part of a larger complex should have received more attention. This reviewer believes that the machine tool industry's significance and its relationship to virtually all other metal products required more extensive treatment—at least a section to itself. Certainly the complete absence of the construction industry—responsible for America's homes, commercial buildings and other structures—is a glaring omisison.

The authors state that their manuscript was read by authorities to insure technical accuracy, and the infrequent factual errors do not decrease the considerable value of this book to those concerned with product development. —JK

World Trade in Plastics

Abstracted from "World Trade in Plastics," by Erich Gansmuller and R. W. Crawford, Monsanto Plastics Div., Modern Plastics, Oct. 1957, 575 Madison Ave., New York 22.

This article describes the status of plastics as a world engineering material. Volume of production, major producers in various countries, principal types produced, present and future trends are discussed.

Orderly Creative Inventing

Abstracted from "Orderly Creative Inventing" by W. H. Middendorf, Univ. of Cincinnati, and G. T. Brown, Jr. National Cash Register Co.; Electrical Engineering, Oct. 1957.

First step in the proposed plan requires a definition of the problem. At the beginning this will usually be vague. Some tentative definitions may result; perhaps only the area of endeavor may be defined.

The second step is to gather facts. Invention necessarily requires the availability of a wealth of information. The greater the storehouse of knowledge, the more likely the success.

To this, one must add an organized method of attack which will allow him to call upon this storehouse for ideas in such a form that they are simple enough to comprehend and visualize. An ability to visualize reality is recognized as one of the most important facilities the inventor must possess.

The suggested third step is to reduce the whole problem to a number of smaller problems, each easier to comprehend and visualize as reality.

Fourth step is the heart of this plan for orderly creative inventing.

To facilitate assigning fewest limitations to each element, the problem, already simplified by division, must be transformed into a listing of physical states, properties, or functions of the subunits taken one at a time.

This process usually is aided by jogging the mind with such questions as:

What must this element accomplish?

How or where must this member communicate with its environment?

What properties must the material possess?

After each unit has been completely described by the parameters, determine as many alternate methods as possible for providing these basic requirements. This is the fifth step, and where the would-be inventor must show originality. The point is, however, that the subunits are now simplified enough so they can readily be described with regard to functional requirements.

The sixth step is simply a discerning selection from the many solutions generated.

THEORY AND DEVELOPMENT OF ATOMIC ENERGY—Pamphlet, 32 pp. Cartoon-text format makes the mechanics and future promise of this new energy form easily understandable. Traces development of atomic research from early discoveries of Henri Becquerel and the Curies. Some peacetime uses of the atom are described, also those giving promise for the future. General Dynamics Corp., 445 Park Ave., New York 22.

COMMERCIAL-GRADE ZIRCONIUM—Booklet, 8 pp, reviews established and potential applications, gives corrosion and physical properties and discusses methods of fabrication. Columbia-National Corp., Cambridge 42, Mass.

ELECTRONICS ENGINEERING AND PRODUCTION—Brochure, 12 pp, provides facts and figures on engineering and production capabilities. Lear, Inc., 3171 S. Bundy Drive, Santa Monica, Calif.

DATA PROCESSING TECHNIQUES—Booklet, 8 pp, describes management consultant service emphasizing data-handling techniques and equipment related to personnel, production, engineering, quality control. Cresap, McCormick and Paget, 342 Madison Ave., N. Y.

ENGINEERING AND MANUFACTURING FACILITIES—Bulletin, 4 pp. explains mechanical, electronic and hydraulic engineering and manufacturing facilities. ConRay Corp., 29 W. Apple St., Dayton, Ohio.

OSCILLOGRAPHIC RECORDING SYSTEMS—Catalog 16 pp. Descriptions, specifications and prices of oscillographic recording systems, accessories and unit instruments. Illustrated with photos and circuit diagrams. Sanborn Co., 175 Wyman St., Waltham 54, Mass.

HIGH-STRENGTH STEELS—Booklet, 16 pp. Structural steels with yield strengths over 200,000 psi are discussed. Technical data, tables of composition and properties, and application information are included. Steels, originally used almost exclusively for aircraft parts, are now being considered for many industrial applications where weight and space-saving advantages offset higher fabrication costs. Climax Molybdenum Co., 500 Fifth Ave., New York 36.

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Make several thousand burr-free cuts per hour in bar stock

Combination shearing-breaking action parts bar stock without burring and minimum distortion. Handles up to ⅜" round bar stock—square, rectangular, and hex shaped bar stock can be parted when machine is equipped with special die heads.

Material range is from hot rolled bar stock to stainless steel and other high alloy materials. The harder the material is the better it parts.

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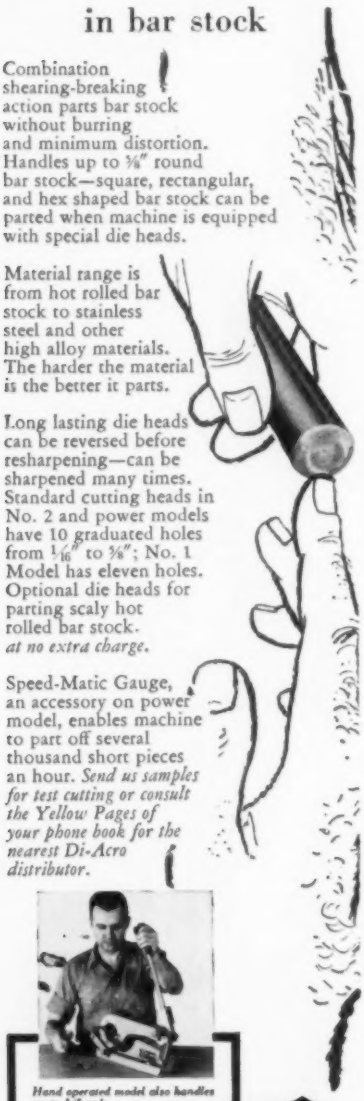
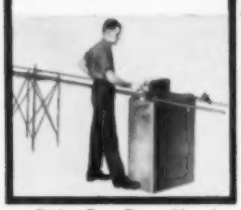
Speed-Matic Gauge, an accessory on power model, enables machine to part off several thousand short pieces an hour. *Send us samples for test cutting or consult the Yellow Pages of your phone book for the nearest Di-Acro distributor.*



Hand operated model also handles up to ⅝" rods.



Di-Acro Power Parter with stock stand and Speed-Matic Gauge.

This ¼" stainless steel bar stock has been "parted" in a Di-Acro Rod Parter. Shiny edges show where rod was sheared, then fractured or "parted off." Will clear hole its own diameter.

*pronounced die-ack-ro

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Publisher's Postscript...

Where US STRENGTH Really Is

It took sputnik I to focus commanding national attention on what American Industry is doing in product research and development. Almost overnight, product-development engineers have been pushed into the limelight of national publicity to explain what they have been doing all these years . . . why we . . . the greatest engineering nation on earth . . . don't have a bigger and better satellite ready.

Many explanations have been widely publicized—but what has *not* been published is of even greater importance to all of us.

We may not be ready yet to display our technological developments in the sky, because our engineering enterprise and our scientific research have been applied on a broader scale. We have far greater breadth and depth in product research and development facilities and trained manpower than Russia—or any other nation—can possibly have in many years to come.

Under our free-enterprise economy, company after company, from Maine to California, from Minnesota to Texas, has built or is building extensive product research and development facilities (Nov. 18, p. 23). In the metal-product field alone, more than 10,000 companies either already have, or are starting research programs. Well over 450,000 engineers, scientists, and technicians are devoting their full time to planning, designing, and building, new products or improving those now being made.

Many of these engineering and product-development organizations are surrounded with extensive facilities . . . research . . . design . . . development . . . testing . . . model shops . . . many of them distinctly separated from product-manufacturing operations. They cover all manner of products from the smallest to the most complex potential one of the future. There isn't a branch of metal-product manufacture that is not well represented in this forward move, and throughout it all there is a competitive sense of urgency for superior achievement, seldom evident in any government-controlled operations. America's unmatched product-design team is backed by Metalworking's investment of $4.7 billion specifically earmarked for product development in 1957. Metal-product manufacturers are spending two-thirds of all the money invested by all industry in product research and development, even though it represents only a third of all manufacturing.

What does this all mean? . . . Simply this: We in America now have . . . and are expanding at a terrific rate . . . far more product-development facilities and trained engineering personnel at work, on a wider range of engineered equipment, then all the rest of the world combined.

Don't let's sell America short because there are sputniks in the sky. We may be a bit backward in our showmanship . . . perhaps too busy doing our job . . . to make publicity capital out of our enormous engineering and product-development strengths. We have them in depth in government operations, but we have much more in private industry. The ratio is 70% private, 30% government.

Our strength lies in the great number of these widely diversified and unusually competent design-engineering and product-development centers operated by private industry throughout the nation. And neither Russia or any other power on earth can match our stride. —A. H.

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74 for Your Information (personal)

Nylons for the Kids

Tough, lightweight, molded nylon is getting plenty of product jobs—and some that are fun as well. DuPont reports the nylon propeller blades pictured here "last more than 10 times as long as conventional ones," can be used with free-flight, radio control, or control-line gas-engine model planes. Grish Bros., Box 52, St. John, Ind., makes them in a variety of sizes. Retail prices is about 50¢.

This One's a Self-feeder

A new approach to mechanical-pencil design brings a slender, lightweight writing instrument that feeds lead as it writes, eliminating the constant manual adjustments necessary with many pencils of this type. The pencil has no springs, only five working parts: spiral element; clutch with an expeller inside it; slotted, tipped tube; friction strip. Principle of its operation is complex, though—as complex as the motions involved in writing, the inventor says. It feeds only when the pencil is lifted from the paper—not while writing. Constant contact between lead and paper would give no feed—but one can't write very well that way. Tru-Tip Writing Instrument Corp., 153-09 Tenth Ave., Whitestone 57, N. Y. sells it. Price: $1.

Put It in a Box

Everything *including* the kitchen sink is going into "packaged" products these days—and space-conscious customers snap them up. Two recent examples: General Air-conditioning Corp.'s "Cabinet Kitchen" (see photo), and Hull Arts Products' "Portable Art Studio."

The Cabinet Kitchen packs refrigerator, stove (with oven, if desired), freezer, and sink in a cabinet only 29 in. wide, offered in a choice of wood finishes. It's not cheap (price ranges from about $500 to $600), but it certainly looks efficient.

The Portable Studio, more modestly priced ($89.50) is 19 by 22½ by 37½ in., features a pop-up easel, palette, and storage space for half a dozen 16 by 20 canvases.

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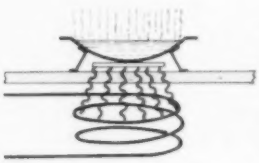
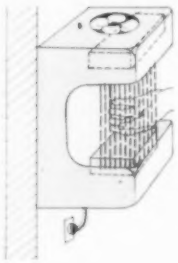
WHY DON'T THEY RESEARCH and DEVELOP...

. . . a photographic printing process based on the same principles reported Nov. 18, p. 8. That DuPont process (for plate making) uses a photosensitive polymer exposed through the negative with ultraviolet light; the exposed area becomes hardened and a brief water-wash removes the unexposed material. Couldn't the polymer be a very thin coating of black covering a white undercoating? Amateur photographers would then print (or enlarge) with an ultraviolet lamp and develop in water to get a black-and-white. No developer, no hypo, no messy chemical preparation.



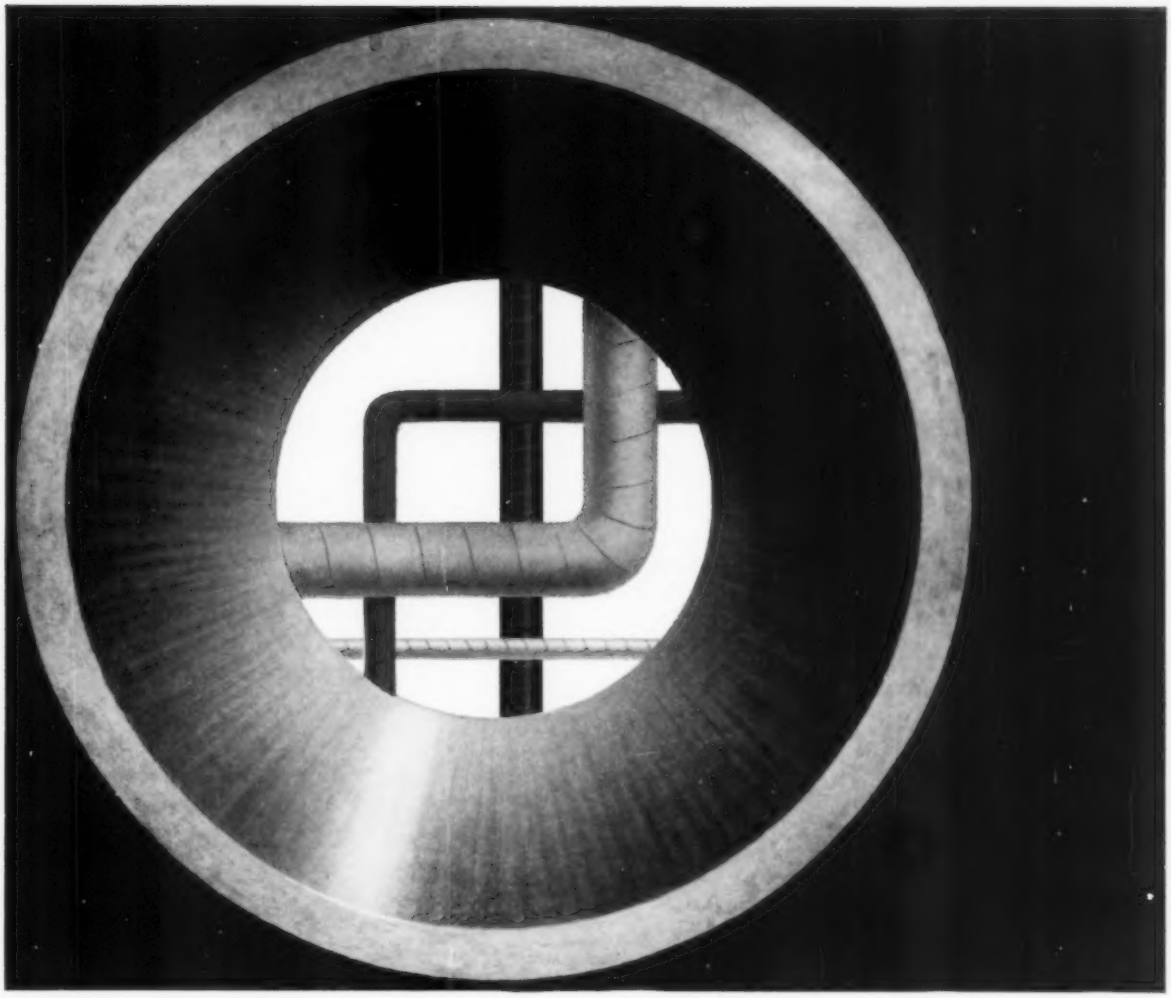
. . . lightweight and attractive dinnerware with metal foil or conductive paint of some kind molded in? These would keep food and beverages hot right at the table or wherever an induction heating coil was installed. A central unit could serve as a centerpiece at the table. Individual coils at place settings could be used, though at the risk of making the silverware too hot to handle. —Kenneth Kahn, *Yuma, Ariz.*



. . . a hand drier for home use like those used in restaurant rest rooms? An electric eye sets the unit in operation when the beam is broken. An electrical or chemical element removes moisture and a small blower moves warm air over the hands, if necessary. The entire unit should function by plugging into a standard wall outlet. —V. J. Perillo, *Philadelphia*

. . . some final solution to the hydraulic-system leakage problem. After so many years of trying all sorts of metal-to-metal and rubber-sealed fittings, systems still leak—and will, as long as power is transmitted by a thin fluid. The National Inventors Council suggests using a new material having the stress distribution properties of water or oil: "It should be resistant to leakage, that is, a solid or semi-solid. Very soft rubbers approach this requirement." Now combine this with pulse power and you have a system with no leakage.

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer



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